GRAND CANYON
FISHERIES INTEGRATED DATABASE

Phase I: A Catalogue of Fisheries Data From Grand Canyon

Preliminary Phase I Completion Report

BIO/WEST, Inc.

Resource Management and Problem Solving Services

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DRAFT

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Preliminary Phase I Completion Report

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EXECUTIVE SUMMARY

The Glen Canyon Environmental Studies (GCES) has coordinated research on native and endangered fish in Grand Canyon since its inception on December 8, 1982. Data were collected under GCES Phase I (1982-88) and Phase II (1988-94), and the need for data integration was identified as a component of the Phase II Draft Integrated Research Plan. BIO/WEST was requested by GCES to initiate development of a Grand Canyon Fisheries Integrated (GCFIN) Database that includes historical accounts, and past and ongoing collections. This GCFIN Phase I Report includes project background and objectives; an overview of the project databases; database structures, relational links and codes; and identifies common elements among the different databases. A GCFIN Phase II Report will identify and develop common data structures for dataset integration, and a Phase III Report will identify informational layers for future integration of datasets into a Geographic Information System (GIS).

Historical accounts were descriptive and did not include quantitative data for use in a detailed database. Past collections included archival collections, reports of species occurrence and relative abundance, and most recently, quantitative datasets. The ongoing collections include data collected as part of the Native and Endangered Fish Studies component of the GCES Phase II Draft Integrated Research Plan. Included are investigations by Arizona Game and Fish Department, U.S. Fish and Wildlife Service, Arizona State University, and Bureau of Reclamation contracts (e.g., BIO/WEST). Most data collected under Phase II are being computerized into field-specific datasets at the time of collection.

The data structures of each investigative group differ, primarily because data collection was driven by specific study objectives. Dataset integration is limited by incompatibility of collection methods, data formats, and code designations, although data formats and codes can often be made compatible through internal translations. Possibilities exist for developing some common data structures, however, such as for water quality and fish capture information. This report identifies approximately fifteen water quality data fields and twenty fish capture fields that are common among most of the databases and have potential for integration into common data structures. These common data structures will be identified, described, and further developed in the GCFIN Phase II Report.

The GCFIN Database is anticipated to contain an estimated 500,000 records at the conclusion of GCES Phase II, at the end of 1994. Historical accounts and collections through the late 1970's are not expected to add substantially to the volume of the database. Data from GCES Phase I include about 100,000 records, and Phase II is expected to generate an additional 400,000 records. Included are data from the Colorado River, Glen Canyon Dam to Pearce Ferry; Little Colorado River; and other major tributaries in Grand Canyon. Data types include water quality, fish capture information, morphometrics and meristics, food habits, habitat, invertebrates, organics, fish movement, and associated fish sampling information.

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INTRODUCTION

This document is the Preliminary Phase I Completion Report submitted to Bureau of Reclamation by BIO/WEST, Inc. (B/W) in partial fulfillment of Contract No. 0-CS-40-09110, Modification No. 015, entitled Grand Canyon Fisheries Integrated (GCFIN) Database. This GCFIN Phase I Report describes and catalogues databases resulting from past and ongoing fisheries investigations in Grand Canyon. It includes project background and objectives; an overview of the project databases; database structures, relational links and codes; and identifies common elements among the different databases. This report is preliminary as some database descriptions have not been received to date; a Final Phase I Completion Report will be submitted after the information is received. A GCFIN Phase II Report will identify and develop common data structures for dataset integration, and a Phase III Report will identify informational layers for future integration of datasets into a Geographic Information System (GIS).

BACKGROUND

The Glen Canyon Environmental Studies (GCES) has coordinated the collection of virtually all fisheries data and information from the Colorado River and its tributaries in Grand Canyon over the last decade. These studies were initiated by the Department of Interior on December 8, 1982, and have involved a number of agencies, universities, and private groups. Significant amounts of data were collected under Phase I of GCES (1982-88), and are currently being collected under Phase II (1988-94). Details of research components and study plans are provided in the GCES Phase II Draft Integrated Research Plan (GCES 1990). Data and associated documentation provided in the following report were collected as part of the GCES Phase II Native and Endangered Fish Studies. Prior to the GCES, fisheries investigations were conducted independently by universities, agencies, and individuals.

The GCES realizes that a centralized database, that incorporates all fisheries data, is important to managers and administrators who make decisions that affect all Grand Canyon resources. This objective represents a significant challenge as the fisheries information ranges in complexity from historical notations of early canyon pioneers to detailed descriptions of individual fish habits collected by a number of different organizations with a variety of purposes. Additionally, some of the earlier information has not been entered into computer files while more recent studies designed to precisely document life histories and ecology of fishes have produced large and complex computer databases. The GCES is working to achieve a uniform, centralized database by initiating this Grand Canyon Fisheries Integrated (GCFIN) Database project to consolidate and document the individual fisheries databases and to integrate them where possible. Fisheries investigations included in this integrated database were conducted by Arizona State University, U.S. Fish and Wildlife Service, University of Arizona, Arizona Game and Fish Department, Northern Arizona University, and BIO/WEST Inc.

A similar integrated database is being developed by the Navajo Natural Heritage Program (NHP) for the Little Colorado River (LCR). Data storage formats and database structures are similar to those identified and developed for databases contained in this document, to facilitate integration of the two databases. BIO/WEST has met with members of the NHP to insure integration and compatibility of databases.

Many data fields identified in this database are compatible with the existing database for endangered fishes of the Upper Colorado River Basin (McAda 1987). The framework for the GCES Database is an assimilation of datasets compiled from various investigators, each with field-specific data entries and designated codes. Many of these fields and codes are compatible, i.e., they are the same, interchangeable, or easily converted. This compatibility allows for integration of key elements of these databases for use by Upper and Lower Basin biologists and administrators.

Data contained in the GCFIN Database will be integrated into a Geographic Information System (GIS) to facilitate viewing multiple layers of information and analysis of multiple datasets or partitions. This will allow for interfacing of fishery data with databases of other disciplines (e.g., geomorphology, riparian, cultural, etc.) to provide a more comprehensive representation and understanding of resources in Grand Canyon.

OBJECTIVES

This document is the Preliminary Phase I Completion Report for the GCFIN Database. A description of the project is provided in a Technical Proposal (Valdez and Hougaard 1993), which identifies three phases and the following associated objectives:

Phase I

Objective 1: Procure documented database structures and accompanying sample datasets from each fishery researcher in Grand Canyon, with assistance from GCES.

Objective 2: Describe and catalogue data structures from each researcher database.

Objective 3: Identify field formats and data codes common to databases.

Phase II

Objective 4: Assist GCES in developing a prototype database that will house all the databases.

Objective 5: Assist GCES in developing necessary templates for integrating data partitions from the various databases.

Phase III

Objective 6: Identify GIS informational layers for future integration of database partitions.

OVERVIEW OF DATABASES

The following overview provides a list of study objectives for each GCES fisheries research program and a general description of associated databases. General database descriptions include software used to enter, store, maintain, and analyze data, as well as a list of database specifications. The list includes the project file names, a description of the contents of each file, the number of records in the file, the length of each record in characters or numeric digits, the size of the file in bytes, and the anticipated number of file records at the conclusion of the study. Most of the information in this overview was received directly from each investigator.

ARIZONA STATE UNIVERSITY

ASU Study Objectives

A synopsis of the objectives of Arizona State University's (ASU) GCES Phase II investigation (to be completed October 1995) as described in their July 1990 Technical Proposal (Douglas and Marsh 1990):

> "Although research to date has provided valuable information pertaining to life history and ecology of humpback chub in the Grand Canyon, a number of critically important questions remain unresolved, and data are required for future management of this unique and imperiled species. In particular, the duration and extent of movements by juvenile and adult humpback chub in the LCR, and their span of residency within that river are generally unknown, as is the basic reproductive biology of this fish. Investigations that will quantitatively define these major life-history characteristics are the focus of this research proposal."

General Description of ASU Database

Arizona State University's data are stored in ASCII files on an IBM 3090 mainframe computer. They use the Wylbur mainframe editor to enter and maintain data, and Statistical Analysis System (SAS™) for analysis. Their preferred file format for data distribution is non-delimited ASCII files. The file names listed below were assigned by BIO/WEST since the actual file names were not provided in the ASU database documentation. Table 1 lists the specifications for the ASU database.

Table 1. Database specifications for the ASU studies.

File Name	# Records	Record Length	Approximate Size(bytes)	Anticipated# Records	Contents
ASU91.DAT	10,151	65	~659,815	10,151	Fish collection data, 1991
ASU92.DAT	9,120	65	~592,800	9,120	Fish collection data, 1992
ASU93.DAT	>8,941	65	~581,165	>8,941	Fish collection data, 1993

U.S. FISH AND WILDLIFE SERVICE

USFWS Study Objectives

The major purpose of the U.S. Fish and Wildlife Service (USFWS) GCES Phase II fisheries studies is to address the reasonable and prudent alternatives proposed by USFWS in the Biological Opinion (jeopardy determination) of 1978, and the Draft Biological Opinion of 1994 on the operation of Glen Canyon Dam. The focus of these investigations is on Conservation Measures 4, 5, 6, and 7 contained in that opinion.

The objectives of the USFWS studies (completion date of October 1995) according to Gorman (1994) are:

Objective 1: Determine habitat use by humpback chub and other native fishes in the Little Colorado River (LCR).

Objective 2: Evaluate the potential for establishing a second spawning aggregation of humpback chub in other tributaries of the Grand Canyon.

Objective 3: From the perspective of habitat requirements, evaluate how the humpback chub and native fishes are affected by the operation of the Glen Canyon Dam.

General Description of USFWS Database

Information not available at this time.

UNIVERSITY OF ARIZONA

U of A Study Objectives

The University of Arizona studies (completion date of October 1993) were conducted under contract with USFWS as part of their tributary studies. The objectives of the USFWS GCES Phase II tributary studies according to Gorman (1994) are:

Objective 1: Describe and determine the availability of aquatic habitats on a seasonal basis.

Objective 2: Determine seasonal patterns of distribution and habitat use by native and exotic fishes.

Objective 3: Identify information and future studies required for possible enhancement of environmental conditions to protect and promote fish and wildlife populations in tributaries of the Colorado River.

Studies addressing these objectives led to the following four Master of Science theses: Allan 1993, Mattes 1993, Otis 1994, and Weiss 1993.

General Description of U of A Database

Information not available at this time.

ARIZONA GAME AND FISH DEPARTMENT

AGFD Study Objectives

The objectives of the Arizona Game and Fish Department (AGFD) GCES Phase II studies (completion date of July 1995) according to Arizona Game and Fish Department (1990) are:

Objective 1: Continue the AGFD monitoring and research program for native fishes of the Colorado River and its tributaries in Grand Canyon.

Objective 2: Identify temporal and spatial distribution patterns and movements of early life stages of fishes in the Little Colorado River and, if necessary, other tributaries.

Objective 3: Provide for the propagation of native fishes of the Colorado River in Grand Canyon for use in laboratory or hatchery based studies necessary to satisfy the needs of the Section 7 Conservation Measures.

Objective 4: Determine changes in environmental conditions in mainstream and tributary confluence zone native fish rearing habitats under different flow regimes.

Objective 5: Determine algal and invertebrate standing crops and their relative contributions to diets of young native fishes in tributary, backwater, and mainchannel habitats under different flow regimes.

Objective 6: Determine the behavioral responses of larval to juvenile native fishes to changing environmental conditions in rearing habitats during controlled flows.

Objective 7: Determine age structure and growth rates of native fishes of the Colorado River in Grand Canyon. Relate these life history features to hydrologic and thermal conditions experienced by the fishes during their growth to present size.

Objective 8: Compare otolith edge chemistry of native fishes collected in tributary and mainstream habitats for use in growth and movement analysis.

Objective 9: Determine the extent to which limnological factors, with emphasis on water chemistry and aquatic productivity, potentially limit the distribution and abundance of native fishes in the Little Colorado River and other tributaries which might serve as streams for augmentation of humpback chub in Grand Canyon.

General Description of AGFD Database

The Arizona Game and Fish Department's database consists of two sets of data files for native fish studies; one for the Little Colorado River Studies and one for the mainstem Colorado River Studies. Arizona Game and Fish Department uses dBASE IV™ and FoxPro™ on DOS-based personal computers to store and maintain data, and dBASE IV™ and SPSS/PC™+ for data analysis. Their preferred file format for data distribution is dBASE IV™ files. Tables 2 and 3 list the specifications for the two components of the AGFD studies.

Table 2. Database specifications for the AGFD Little Colorado River Native Fish Studies.

File Name	# Records	Record Length	Size (bytes)	Anticipated # Records	Contents
ALGEMAS1.DBF	574	122	70,990	574	Algae chlorophyll analysis data; grids and quarterly, 1993
ALGAECOL.DBF	433	68	30,182	433	Algae and benthos collections (quarterly trips), 1991-1993
QBENTHOS.DBF	156	128	20,930	200	Quarterly benthos analysis data, 1993
BEHAVIOR.DBF	335	457	155,113	400	Behavioral data, 1991-1993
DRFTMAST.DBF	4,989	82	410,028	6,000	Drift analysis data, quantification of taxa, 1991-1993
DRIFTBIO.DBF	891	146	131,464	1,500	Drift biomass data, 1991-1993
HABITAT.DBF	1,049	144	152,370	1,049	Larval fish habitat data (grids), 1993
AVAILABL.DBF	9,378	80	750,914	9,378	Longitudinal habitat availability data, 1992-1993
HABUSE.DBF	11,084	89	987,278	11,084	Longitudinal habitat use data, 1993
LARVPRES.DBF	3,202	59	189,368	3,202	Longitudinal survey presence/absence data 1992
PRES193.DBF	4,339	70	304,244	4,339	Longitudinal survey presence/absence data 1993
MAS1FC93.DBF	7,820	163	1276,038	18,000	Fish collections data, 1993
MASTFC92.DBF	4,530	163	739,768	4,530	Fish collections data, 1992
MASTFC91.DBF	8,632	163	1408,394	8,632	Fish collections data, 1991
MASTERFC.DBF	20,982	163	3421,444	31,162	Fish collections data, 1991-1993
VISCMAST.DBF	3,488	168	586,978	4,500	Viscera analysis data, 1988-1993
MOVEMAS1.DBF	729	109	80,519	729	Larval fish movement data (traps), 1993
FCHABUSE.DBF	630	24	15,346	10,000	Fish collections habitat use data, 1991-1993
[1]HABPHOTO.DBF	-	-	-	-	Habitat photograph analysis (grids), 1993
[1]HABZOOPL.DBF	-	-	-	-	Habitat zooplankton analysis (grids), 1993

[1]Database file not yet created

Table 3. Database specifications for the AGFD Mainstem Colorado River Native Fish Studies.

File Name	# Records	Record Length	Size (bytes)	Anticipated # Records	Contents
ALLSONDE.DBF	8,325	57	475,071	30,000	Data from Hydrolab DataSondes
A_MASTER.DBF	840	82	69,586	1,200	Type A sample habitat data
BENTMAST.DBF	1,538	60	92,666	3,000	Benthos data
DIET_ANA.DBF	69	53	322	1,500	Fish diet analysis (stomach samples)
FISH_ALL.DBF	19,323	62	1,198,604	30,000	Fish capture data
MAP.DBF	242	110	27,294	400	Plane table mapping data
MAST_ALL.DBF	862	87	76,020	1,200	Master data sheet data
OPP_ALL.DBF	1,189	126	150,776	1,500	Opportunistic sampling data
PLANKTON.DBF	4,137	20	82,998	15,000	Plankton data
PRB3.DBF	7,014	47	330,204	7,014	Type B sample habitat data
SEDIMENT.DBF	506	56	28,626	750	Sediment data

BIO/WEST

B/W Study Objectives

The BIO/WEST (B/W) Grand Canyon fisheries database consists of two sets of files; one for the Mainstem Humpback Chub Studies (completion date of October 1994) and one for the Hualapai Aquatic Resources Studies (completion date of April 1995). Each study has its own set of objectives which are described below.

1) Mainstem Humpback Chub Studies

The purpose of this B/W study is to describe the ecological and limiting factors of all life stages of humpback chub in the mainstem Colorado River, Grand Canyon, and the effects of Glen Canyon Dam operations on the humpback chub. The B/W investigation is being conducted in the mainstem Colorado River in Grand Canyon, from Lees Ferry (RM 0) to Diamond Creek (RM 226), concurrent with the AGFD mainstem studies. The specific objectives of the humpback chub investigations are:

Objective 1: Determine resource availability and use (i.e., habitat, food, water quality) of humpback chub in the mainstem Colorado River.

Objective 2: Determine distribution, abundance and movement of humpback chub in the mainstem Colorado River.

Objective 3: Determine reproductive capacity and success of humpback chub in the mainstem Colorado River.

Objective 4: Determine survivorship of early life stages of humpback chub in the mainstem Colorado River.

Objective 5: Determine important biotic interactions with other species for all life stages.

Objective 6: Determine the life history schedule for the Grand Canyon humpback chub population.

2) Hualapai Aquatic Resources Studies

The objectives of this investigation of the Lower Grand Canyon, from National Canyon (RM 166.4) to below Pierce Ferry at Lake Mead (RM 280) are:

Objective 1: Monitor the effects of interim flows from Glen Canyon Dam on the distribution, abundance, and behavior of native and non-native adult fish.

Objective 2: Monitor the effects of interim flows from Glen Canyon Dam on the distribution, abundance, and behavior of the larval and juvenile stages of native fishes.

Objective 3: Monitor the effects of interim flows from Glen Canyon Dam on the reproduction, food habits, and patterns of habitat use of piscivorous non-native fishes that may prey on native fishes.

Objective 4: Monitor the effects of interim flows from Glen Canyon Dam on the environmental conditions in the tributary mouths and shallow shoreline habitat. This will include water quality and degradation and/or aggradation of sediments.

Objective 5: Monitor the effects of interim flows from Glen Canyon Dam on the food base including productivity and algal standing crops.

General Description of B/W Database

The two B/W studies were conducted using similar sample designs and protocols (e.g., for fish sampling and water quality collections), so file structures for those datasets are nearly identical. The humpback chub database contains additional data files for information specific to humpback chub (e.g., morphometrics and meristics, scale analyses, radiotelemetry). BIO/WEST uses dBASE IV™ to store and maintain data, and dBASE IV™ and SYSTAT™ for data analysis. Tables 4 and 5 list the specifications for the B/W mainstem and Hualapai databases.

Table 4. Database specifications for B/W Mainstem Humpback Chub Studies.

File Name	# Records	Record Length	Size (bytes)	Anticipated # Records	Contents
NETTING.DBF	16,643	192	3,080,614	16,643	Netting and trapping sample data, Oct 1990 - Nov 1993
ELECTRO.DBF	4,612	182	850,018	4,612	Electrofishing sample data, Oct 1990 - Nov 1993
SEINE.DBF	958	217	202,814	958	Seining sample data, Oct 1990 - Nov 1993
CHUB.DBF	6,294	214	1,235,258	6,294	Humpback Chub morphometrics and meristics, Oct 1990 - Nov 1993
FISH.DBF	26,542	163	4,194,948	26,542	All fish capture data, Oct 1990 - Nov 1993
SURVEIL.DBF	1,600	111	290,626	1,600	Radiotelemetry surveillance, Oct 1990 - Nov 1992
OBSERV_H.DBF	260	206	29,854	260	Header for radiotelemetry observations, Oct 1990 - Nov 1992
OBSERV_M.DBF	2,025	149	302,975	2,025	Movement for radiotelemetry observations, Oct 1990 - Nov 1992
SCALES.DBF	157	133	22,099	157	Humpback Chub scale analyses, Oct 1990 - Nov 1993
JUVHAB.DBF	282	155	44,832	282	Juvenile habitat measurements, Oct 1990 - Nov 1993
DRIFT.DBF	570	218	125,030	570	Drift net sample analysis data, Oct 1990 - Nov 1993
FOOD.DBF	552	253	142,570	552	Stomach pumping analysis data, 1993
REMOTE.DBF	26,583	14	452,493	26,583	Remote radiotelemetry station data, Oct 1990 - Nov 1992
DATASOND.DBF	43,586	45	2,000,000	43,586	Datasonde water quality data, Oct 1990 - Nov 1993
SURVEYOR.DBF	5,161	51	265,000	5,161	Surveyor II water quality data, Oct 1990 - Nov 1993

Table 5. Database specifications for B/W Hualapai Aquatic Resources Studies.

File Name	# Records	Record Length	Size (bytes)	Anticipated # Records	Contents
NETTING.DBF	1,202	213	267,869	2,000	Netting and trapping sample data, May 1992 - Dec 1994
ELECTRO.DBF	520	214	121,311	800	Electrofishing sample data, May 1992 - Dec 1994
SEINE.DBF	197	234	57,374	300	Seining sample data, May 1992 - Dec 1994
FISH.DBF	3,010	216	612,975	4,750	All fish capture data, May 1992 - Dec 1994
DRIFT.DBF	138	318	44,654	220	Drift net sample data, May 1992 - Dec 1994
DATASOND.DBF	1,954	45	90,000	3,070	Datasonde water quality data, May 1992 - Dec 1994
SURVEYOR.DBF	243	51	12,500	380	Surveyor II water quality data, May 1992 - Dec 1994

BIO/WEST is also incorporating humpback chub data into a Geographic Information System (GIS). The GIS data are distinct and link to field-specific data. Some of the GIS information layers are being developed by GCES, but those developed by B/W are digitized using Arc/CAD™ software on an IBM compatible PC. They are maintained and further developed using Arc/INFO™ software on a Sun Sparcstation 2, and are compatible with the GCES GIS database. The GIS products are in the process of being developed, so the quantity of GIS data in the following tables is only an estimate at this time. Table 6 lists the specifications for the B/W mainstem GIS database.

Table 6. GIS database specifications for B/W mainstem humpback chub studies.

GIS Data	# Files	Anticipated Size (bytes)	Contents
Sampling Location Maps	2	~1,000,000	Net and trap locations plotted on orthophoto overlays
Surficial Habitat Maps	27	~100,000	Surficial hydraulic features outlined on aerial photos for four selected sites
Hydraulic Maps	2	~3,000,000	Surficial hydraulic features and shoreline types mapped on orthophoto overlays from LCR to Tanner
Bathymetric Maps and topo (LCR confluence)	15	~12,000,000	Bathymetry and topo for LCR confluence and rm 58.5, 60.1, 60.8, 64.7
Velocity and bathymetry maps (rm 58.5, 60.1, 60.8, 64.7)	250	~2,000,000	Velocities for rm 58.5, 60.1, 60.8, 64.7
Substrate Maps	1	~45,000	Substrates outlined for LCR confluence
Temperature Maps	67	~190,000	Temperature isopleths for LCR confluence
Fish Photographs	240	depends on resolution	Digitized fish slides

HISTORICAL ACCOUNTS AND PAST COLLECTIONS

Historical accounts and past collections provide valuable insight into fisheries resources of Grand Canyon. Many historical accounts were descriptive and did not include quantitative data for use in a detailed, structured database. The earliest accounts of fish from Grand Canyon are surmised from skeletal parts in 4,000 year-old flood deposits in Stanton's Cave (RM 31.5), and from cultural remains at Catclaw Cave (15 mi below Hoover Dam) that date from about 1100 A.D. Of the early explorers through Grand Canyon, starting with Major John Wesley Powell in 1869, none reported on the fish from the region.

Past collections included archival collections, reports of species occurrence and relative abundance, and most recently, quantitative datasets. The first written description (and photographs) of fish from Grand Canyon was of "bony tail" by Ellsworth and Emery Kolb in 1908. Collections by R.R. Miller (specimens stored at University of Michigan) in the mid to late 1940's provided the first quantitative information with morphometrics and meristics of several specimens of Gila sp. R.D. Sutkus collected additional specimens in the early 1970's, which are in the collection at Tulane University. Various surveys from the 1950's through 1970's reported occurrence and relative abundance (i.e., abundant, common, rare) of fish species, but little information on habitat and other associated parameters. Surveys of the Colorado River and its tributaries in Grand Canyon, by Northern Arizona University in the late 1970's, and by the USFWS in the early 1980's provided the first structured dataset, including collection dates, sites, gears, and habitats, as well as numbers of fish by species and effort expended. Investigations under GCES Phase I in 1984-86 by AGFD were the first comprehensive studies directed at evaluating effects of Glen Canyon Dam operations.

Data associated with historical accounts include archaeological finds, field notes, reports, photographs, and personal communications. Table 7 summarizes historical fisheries records for Grand Canyon, including the source of information, available citations, associated location information, and a description of the data. This information was compiled from Valdez et al. (1991), Kubly (1990), and from information provided by C.O. Minckley (Pers. Comm.).

Table 7. Historical records of humpback chub in the Colorado River in Grand Canyon.

Source	Citation	Location	Data Description
Kolb and Kolb 1914	Kolb and Kolb (1914)	LCR - Beamer's Cabin	Reported as "bonytails", photos
Grand Canyon National Park 1944; N.N. Dodge	Miller (1946)	Bright Angel Creek	Two complete bodies, one partial specimen used to describe species
R.R. Miller 1955	Miller (1955)	Boulder Canyon (Catclaw Cave)	Remains from archaeological site (39 km below Hoover Dam)
Woodbury 1959	Woodbury (1959)		Reported occurrence
Arizona State University, 1963	-		Specimen
J.L. Stone 1964	Stone (1964-65)	Lees Ferry	Reported catches for identification by creel clerk - includes anglers, gill nets and electrofishing
J.L. Stone 1966	Stone (1965-66)	Lees Ferry	All Gila "Rare", No Gila cypha records
Stone and Queenan	Stone and Queenan (1966-67)	Lees Ferry	Reported angler catch G. elegans (54 fish) "common"; G. cypha "Rare"
Grand Canyon National Park 1968			
Miller and Smith	Miller and Smith (1968)	Lees Ferry to Diamond Creek (no defined location)	Reported occurrence
AGFD Personnel	Stone and Rathbun (1967-68)	Lees Ferry	Reported occurrence (17) G. cypha "Common"; G. elegans none
Holden and Stalnaker 1967-73	Holden and Stalnaker (1975)	Glen Canyon	Reported occurrence
Museum of Northern Arizona 1970			
Museum of Northern Arizona 1971			
R.R. Miller 1975	Miller (1975 a,b)		Reported occurrence

Table 7. Continued.

Source	Citation	Location	Data Description
C.O. Minckley 1975	Minckley and Blinn (1976)	LCR	Reported as "Gila elegans"
Suttkus et al 1970-76	Suttkus et al (1976)	mouth of LCR and Shinumo, RM 44, 61.5, 69 and 71	Reported occurrence; museum specimens collected
Suttkus and Clemmer 1976	Suttkus and Clemmer (1977)	1967 below Glen Canyon Dam and Powell Reservoir/1976 Powell Reservoir	Reported occurrence; museum specimen collected
C.O. Minckley 1977	Minckley (1977)	mouth of LCR, RM 69 and 71	Reported occurrence
C.O. Minckley 1976-77	Minckley (1979)		Reported occurrence
Miller 1971	Euler (1978)	Stanton's Cave/Catclaw Cave (near Lake Mead)	Remains
Carothers and Minckley 1977-78	Carothers and Minckley (1981)	LCR area; also Tiger Wash, Big Canyon, Unkar Creek	Complete data set (upstream of confluence, rarely below)
Kaeding and Zimmerman 1979-81	Kaeding and Zimmerman (1983)	In LCR mouth	Complete data set
Miller and Smith 1984	Miller and Smith (1984)	Stanton's Cave	Remains
Jones 1985	Jones (1985)		Remains
Maddux et al 1984-86	Maddux et al (1987)		Complete data set
Wallis, O.L. 1955	Kubly (1990)	Spencer Creek	Reported occurrence
Kubly 1990	Kubly (1990)	Shinumo, Kanab, Bright Angel, Havasu	Complete data set

Past collections have largely been entered into computer files. The computerized databases include information collected by Carothers et al. (1981), Kaeding and Zimmerman (1983), and Maddux et al. (1987) and were described by Kubly (1990). These databases are held by AGFD and are stored in dBASE™ files. The sizes of these files are not available to BIO/WEST at this time, but Table 8 lists the file names and a description of the file contents for these past collections databases. An additional data set was recently identified for morphometric and meristic data collected on the genus Gila from the Grand Canyon region by R.R. Miller in the 1940's. BIO/WEST is working to procure this dataset.

Table 8. Database specifications for past collections.

File Name	Contents
MNACATCH.DBF	Carothers et al. catch file
LKRARE.DBF	Kaeding and Zimmerman rare file
LKPHYS.DBF	Kaeding and Zimmerman physical file
LKCATCH.DBF	Kaeding and Zimmerman catch file
AGFDLARV.DBF	AGFD larval fish file
AGFDHAB.DBF	AGFD habitat file
AGFCATCH.DBF	AGFD catch file

DATABASE STRUCTURES AND RELATIONAL LINKS

The previous Overview section reviewed each Grand Canyon fisheries investigator's database, including the study objectives that drive data collection, computer hardware and software used, number of data files, and file sizes. This section discusses the databases in terms of file organization, file structures, and ways of using data in separate files simultaneously.

Generally, database organization is determined by the quantity and complexity of the data collected. Small quantities of fisheries data can be stored in a single "flat" file (see Figure 1). Large quantities of fisheries data, however, are more easily maintained and analyzed if segregated into separate flat files based on a trip, a month, or a year (see Figure 2). Large quantities of more diverse fisheries information are most efficiently maintained in a "relational" database, that divides different types of data into separate files that can be "linked" together ("related") for analysis (see Figure 3).

A relational database has several advantages:

- Organizes data logically into files of manageable size rather than having a large, cumbersome file containing many, possibly unrelated, data fields.
- Eases database maintenance by centralizing changes or updates.
- Saves computer storage space by minimizing data redundancy

The most straightforward of the Grand Canyon fisheries databases is the ASU database. This database consists of a small number of data fields for information pertaining to individual fish only, so it has a single flat file structure containing all of the fields. The ASU study is a multi-year project resulting in a relatively large quantity of data, hence data are separated into files by year. See Appendix A - DATABASE FILE STRUCTURES for a detailed description of data fields used by ASU.

The USFWS, AGFD, and B/W databases are relational databases. The data fields are organized into many different files based on the type of information being collected and how it will be analyzed. Some files can be linked on a single field, such as date, while others require more than one field to correctly link information in separate files. In addition to linking field-specific files together, the B/W database also has links to its GIS. These GIS links enable selected field-specific information to be displayed on GIS maps (e.g., net, trap, and electrofishing sample locations where humpback chub were caught), as well as retrieval of field-specific data from selections on the GIS display (e.g., all netting data for a selected reach of river). Figure 4 shows an example of linking to GIS. See Appendix A - DATABASE FILE STRUCTURES for detailed descriptions of the data fields and structures for these databases.

A description of the U of A database is not available at this time. Information on possible relational links for the Past Collections database also is not available at this time, but see Appendix A - DATABASE FILE STRUCTURES for descriptions of the data fields and structures for this database.

Record	Date	Time	Species	Length	Weight	Location
1	01/01/91	20:25	HB	215	91	61.3
2	09/23/91	06:15	RB	260	170	61.3
3	01/12/92	18:35	RB	163	28	63.4
4	05/17/92	09:55	FM	374	534	66.5
5	03/24/93	11:40	CC	587	2438	70.0
6	09/03/93	22:20	SB	465	907	71.2

Figure 1. Example of a sngle "flat" file database.

Record	Date	Time	Species	Length	Weight	Location
1	01/01/91	20:25	HB	215	91	61.3
2	09/23/91	06:15	RB	260	170	61.3

Record	Date	Time	Species	Length	Weight	Location
1	01/01/92	20:25	HB	215	91	61.3
2	09/23/92	06:15	RB	260	170	61.3

Record	Date	Time	Species	Length	Weight	Location
1	01/01/93	20:25	HB	215	91	61.3
2	09/23/93	06:15	RB	260	170	61.3
3	01/12/93	18:35	RB	163	28	63.4
4	05/17/93	09:55	FM	374	534	66.5
5	03/24/93	11:40	CC	587	2438	70.0
6	09/03/93	22:20	SB	465	907	71.2

Figure 2. Example of a multiple "flat" file database, divided by year.

Record	Date	Gear	Habitat	Species	Weight	Location	Length	Temp.
1	01/01/91	SE	SH	HB	1	61.3	63	10
2	01/01/91	SE	SH	RB	1	61.3	52	10
3	01/01/91	SE	SH	CP	32	61.3	120	10
4	01/01/91	SE	SH	CP	12	61.3	89	10
5	06/18/93	SE	BW	FM	1	70.0	50	15
6	06/18/93	SE	BW	RB	6	70.0	75	15

Figure 3a. Example of a seining and fish data in "flat" file database

Record	Location	Gear	Habitat	Temp.	Date
1	61.3	SE	SH	10	01/01/91
27	63.5	SE	BW	10	02/15/91
65	68.2	SE	PO	13	02/30/92
107	74.5	SE	PO	15	08/12/92
242	70.0	SE	BW	15	06/16/93
318	126	SE	PO	17	09/29/93

Date	Species	Length	Weight
01/01/91	HB	63	1
01/01/91	RB	52	1
01/01/91	CP	120	32
01/01/91	CP	89	12
10/24/92	RB	45	1
06/18/93	RB	50	1
06/18/93	FM	75	6
08/13/93	SD	20	1

Figure 3b. Example of a seining and fish data in "relational" database.

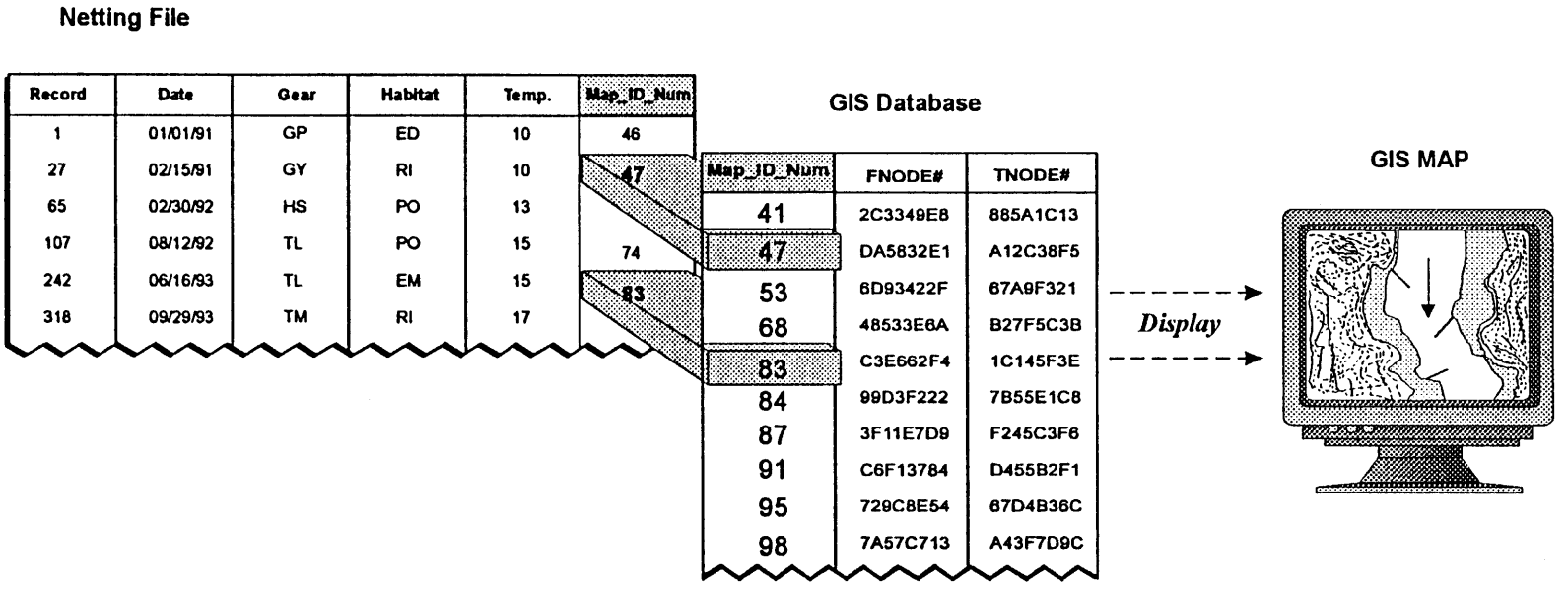

Figure 4. Linking field-specific data to GIS.

Names of the files that can be linked, and fields that can be used for linking, are provided in Tables 9 through 12.

Table 9. Relational links for USFWS database.

File 1	File 2	Linking Fields
MNH	TRN	ID, DATE, TIME
MNH	FSH	ID, DATE, TIME
AHP	TRN	ID, DATE, TIME
AHP	FSH	ID, DATE, TIME
MTP	TRN	ID, DATE, TIME
MTP	FSH	ID, DATE, TIME

Table 10. Relational links for AGFD Little Colorado River Native Fish database.

File 1	File 2	Linking Fields
ALGEMAS1	ALGAECOL	METER, SET_MO, SET_DA, SET_YR, SET_HR, SET_MM, SAMP_NO
ALGEMAS1	HABITAT	METER, SET_MO, SET_DA, SET_YR, SET_HR, SET_MM, CELL_NO
QBENTHOS	ALGAECOL	SET_MO, SET_DA, SET_YR, SET_HR, SET_MM, MILE, SIDE
BEHAVIOR	MAS1FC93	MILE, SIDE, RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM
BEHAVIOR	MASTFC92	MILE, SIDE, RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM
BEHAVIOR	MASTFC91	MILE, SIDE, RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM
DRFTMAST	DRIFTBIO	MILE, SET_MO, SET_DA, SET_YR, SET_HR, SET_MM, NUMBER
HABITAT	MASTFC91	RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM, METER, SIDE
HABITAT	MASTFC92	RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM, METER, SIDE
HABITAT	MAS1FC93	RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM, METER, SIDE
HABITAT	HABPHOTO	RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM, METER, SIDE
HABITAT	HABZOOPL	RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM, METER, SIDE
AVAILABL	HABUSE	RUN_MO, RUN_DA, RUN_YR, MILE, SIDE
AVAILABL	LARVPRES	RUN_MO, RUN_DA, RUN_YR, MILE, SIDE
HABUSE	MASTFC92	MILE, SIDE, RUN_MO, RUN_DA, RUN_YR, PRESERVE
HABUSE	MAS1FC93	MILE, SIDE, RUN_MO, RUN_DA, RUN_YR, PRESERVE
LARVPRES	MASTFC92	RUN_MO, RUN_DA, RUN_YR, SIDE, HM

Table 10. Continued.

File 1	File 2	Linking Fields
PRES193	AVAILABL	RUN_MO, RUN_DA, RUN_YR, MILE, SIDE
MAS1FC93	MOVEMAS1	RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM, MILE, SIDE
MAS1FC93	VISCMAST	RUN_MO, RUN_DA, RUN_YR, MILE, SIDE, STOM_NUM
MASTFC92	VISCMAST	RUN_MO, RUN_DA, RUN_YR, MILE, SIDE, STOM_NUM
MASTFC91	VISCMAST	RUN_MO, RUN_DA, RUN_YR, MILE, SIDE, STOM_NUM
MASTERFC	MOVEMAS1	RUN_MO, RUN_DA, RUN_YR, RUN_HR, RUN_MM, MILE, SIDE
MASTERFC	VISCMAST	RUN_MO, RUN_DA, RUN_YR, MILE, SIDE, STOM_NUM
FCHABUSE	MASTFC91	STUDY, PAGE
FCHABUSE	MASTFC92	STUDY, PAGE
FCHABUSE	MAS1FC93	STUDY, PAGE
FCHABUSE	MASTERFC	STUDY, PAGE

All files in the AGFD mainstem Colorado River Native Fish database contain a STUDY field which can be used to relationally link any set of files. Other fields that can be used as relational links include SITE, HAB_CD, and SPECIES.

Table 11. Relational links for B/W mainstem humpback chub database.

File 1	File 2	Linking Fields
NET_MC	CHUB	KEY[1] (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)
NET_MC	FISH_MC	KEY (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)
ELEC_MC	CHUB	KEY (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)
ELEC_MC	FISH_MC	KEY (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)
SEIN_MC	CHUB	KEY (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)
SEIN_MC	FISH_MC	KEY (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)
OBSERV_H	OBSERV_M	TRIP_NUM, SAMPLE_NUM
NET_MC	GIS Sampling Location Maps	MAP_ID_NUM
ELEC_MC	GIS Sampling Location Maps	START_RM, END_RM

[1]For ease of linking and analysis, the five fields that constitute a unique sample identifier were combined into a single field called KEY.

Table 12. Relational links for B/W Hualapai Aquatic Resources database.

File 1	File 2	Linking Fields
NET_HU	FISH_HU	KEY[1] (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)
ELEC_HU	FISH_HU	KEY (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)
SEIN_HU	FISH_HU	KEY (TYPE+TRIP+SAMPLE_NUM+REACH+CLIPBOARD)

[1]For ease of linking and analysis, the five fields that constitute a unique sample identifier were combined into a single field called KEY.

COMMONALITIES IN EXISTING DATABASES

Resource managers need to use information from all of the fisheries databases, and one of the goals of this project is to integrate the databases where possible. This section examines the Grand Canyon fisheries databases in terms of their similarities and the possibilities for integration.

COMMON ELEMENTS

Fisheries investigators in Grand Canyon have collected a variety of information, which has been incorporated into databases. Figure 5 illustrates the diversity and complexity of fisheries data collected from different locations in Grand Canyon. Researchers collecting data in the mainstem Colorado River, the Little Colorado River, and other tributaries to the mainstem are identified in Table 13. General types of data collected are identified in Table 14, and itemized for each data type in Tables 15-23.

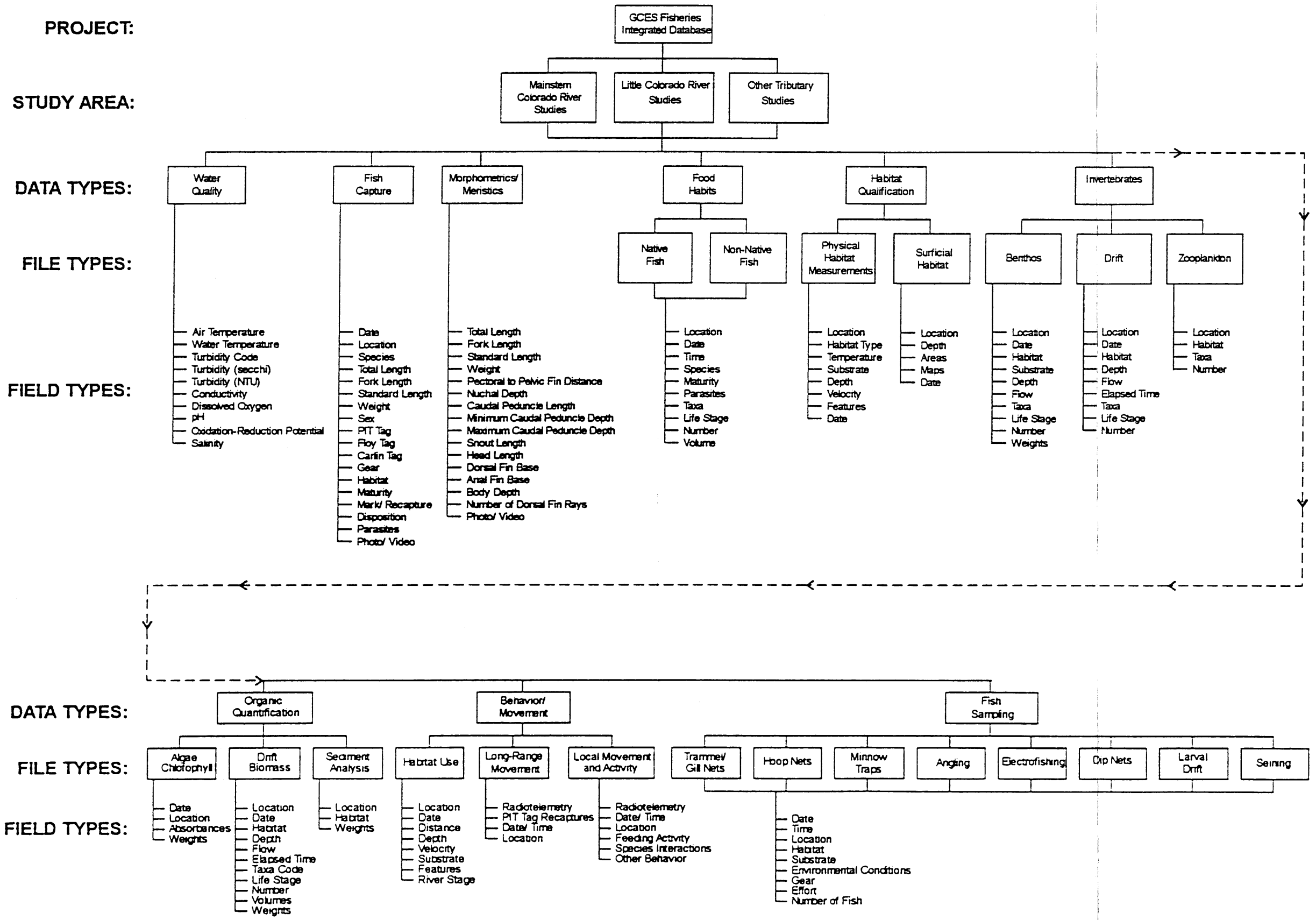

Figure 5. Compartmental representation of data, file, and field types included in the GCES Fisheries Integrated Database.

Table 13. Stream systems investigated by various research groups in Grand Canyon.

Stream System	ASU	USFWS	U of A	AGFD	B/W	Past
Mainstem				✓	✓	✓
Little Colorado	✓	✓		✓		✓
Other Tribs		✓	✓			✓

Table 14. General types of data collected by fisheries researchers in Grand Canyon.

Data Types	ASU	USFWS	U of A[1]	AGFD	B/W	Past
Water Quality		✓	✓	✓	✓	✓
Fish Capture	✓	✓	✓	✓	✓	✓
Morphometric/Meristic					✓	✓
Food Habits (stomach)				✓	✓	
Habitat Quantification		✓	✓	✓	✓	✓
Invertebrates				✓	✓	
Organic Quantification				✓	✓	
Behavior/Movement				✓	✓	
Fish Sampling		✓	✓	✓	✓	✓

[1]Data types determined from Allan 1993, Mattes 1993, Weiss 1993, Otis 1994

Two levels of detail are used to examine more closely the general types of data listed in Table 14. A few of the data types can be examined at the level of database fields (e.g., water quality, fish capture, morphometric/meristic data) because the researchers used similar data collection protocol. The similarity in *Water Quality* data is a result of the equipment used by most of the researchers (e.g., Hydrolab Datasonde™ or Surveyor™ to collect water quality parameters and secchi discs/turbidity meters to collect water clarity information). The similarity within the *Fish Capture* and *Morphometric/Meristic* information is from traditional methodologies for recording fish measurements and related observations by most of the researchers. The remaining data types in Table 14 must be examined at a less detailed level. These data are not collected and recorded in a similar manner as the researchers have different study objectives, different methods, and different ways of recording data. Hence, even apparently common information can be only broadly categorized.

Tables 15 and 16 show the types of *Water Quality* and *Fish Capture* fields collected and which investigators collect them. The information in Tables 15 and 16 generally corresponds to individual data fields. In the following section, COMPATIBILITY OF COMMON ELEMENTS, the specific fields within the *Water Quality* and *Fish Capture* data files of each researcher are compared.

Table 15. Water quality data collected by fisheries researchers in Grand Canyon.

Water Quality Fields	ASU	USFWS	U of A[1]	AGFD	B/W	Past[2]
Temperature		✓		✓	✓	✓
Turbidity - code					✓	✓
Turbidity - secchi		✓			✓	
Turbidity - NTU		✓			✓	
Conductivity		✓		✓	✓	✓
Dissolved oxygen		✓		✓	✓	✓
pH		✓		✓	✓	✓
Oxidation-Reduction Potential		✓		✓	✓	
Salinity		✓		✓		✓

[1]File structures not available at this time.
[2]Not all past collections data records include this information.

Table 16. Fish capture data collected by fisheries researchers in Grand Canyon.

Fish Capture Fields	ASU	USFWS	U of A[1]	AGFD	B/W	Past[2]
Date	✓	✓		✓	✓	✓
Location	✓	✓		✓	✓	✓
Species	✓	✓		✓	✓	✓
Total Length	✓	✓		✓	✓	✓
Fork Length					✓[3]	
Standard Length					✓	
Weight	✓	✓		✓	✓	✓
Sex	✓	✓		✓	✓	✓
PIT Tag	✓	✓		✓	✓	✓
Floy Tag	✓	✓			✓	
Carlin Tag	✓	✓			✓	
Gear Type	✓	✓		✓	✓	✓
Habitat				✓	✓	✓
Maturity	✓	✓		✓	✓	✓
Mark/Recapture		✓		✓	✓	✓
Disposition				✓	✓	✓
Parasites		✓		✓	✓	✓
Photo/Video					✓	

[1]File structures not available at this time.
[2]Not all past collections data records include this information.
[3]For humpback chub only.

Morphometric and Meristic data (Table 17) are collected only by B/W and some past researchers. Complete information on the past collections database is not available at this time, so no detailed comparison of the two datasets was done.

Table 17. Morphometric and meristic data collected by fisheries researchers in Grand Canyon.

Morphometric/Meristic Fields	ASU	USFWS	U of A[1]	AGFD	B/W	Past[2]
Total Length					✓	✓
Fork Length					✓	
Standard Length					✓	
Weight					✓	✓
Pectoral to Pelvic Fin Distance					✓	✓
Nuchal depth					✓	
Caudal Peduncle Length					✓	
Min. Caudal Peduncle Depth					✓	
Max. Caudal Peduncle Depth					✓	
Head Length					✓	
Snout Length					✓	
Dorsal Fin Base					✓	
Anal Fin Base					✓	
Body Depth					✓	
Number of Dorsal Fin Rays					✓	✓
Number of Anal Fin Rays					✓	✓
Photo/Video					✓	

[1]File structures not available at this time.
[2]Not all past collections data records include this information.

Other general types of data collected by fisheries researchers in Grand Canyon include *Food Habits* (Table 18), *Habitat Quantification* (Table 19), *Invertebrates* (Table 20), *Organic Quantification* (Table 21), *Behavior and Movement* (Table 22), and *Fish Sampling* (Table 23). The information in these tables is not specific data fields, but categories of data.

Table 18. Food habits information collected by fisheries researchers in Grand Canyon.

Food Habits Information	ASU	USFWS	U of A[1]	AGFD	B/W	Past[2]
Native Fish				?	✓	
Non-native Fish				?	✓	
Numerical				✓	✓	
Volumetric				✓		

[1]File structures not available at this time.
[2]Not all past collections data records include this information.
[3]For non-native fish only.

Table 19. Habitat quantification methods used by fisheries researchers in Grand Canyon.

Habitat Methods	ASU	USFWS	U of A[1]	AGFD	B/W	Past
Physical Habitat Measurements		✓	✓	✓	✓	✓
Surficial Habitat				✓	✓	✓

[1]Data types determined from Allan 1993, Mattes 1993, Weiss 1993, Otis 1994

Table 20. Invertebrate sampling methods used by fisheries researchers in Grand Canyon.

Sampling Methods	ASU	USFWS	U of A	AGFD	B/W	Past
Benthos				✓		
Drift				✓	✓	
Zooplankton				✓		

Table 21. Organic quantification methods used by fisheries researchers in Grand Canyon.

Methods	ASU	USFWS	U of A	AGFD	B/W	Past
Algae Chlorophyll				✓		
Drift Biomass				✓	✓	
Sediment Analysis				✓		

Table 22. Behavior and movement observations by fisheries researchers in Grand Canyon.

Observations	ASU	USFWS	U of A[1]	AGFD	B/W	Past
Habitat Use			✓	✓	✓	✓
Long-Range Movement					✓	
Local Movement and Activity				✓	✓	

[1]Data types determined from Allan 1993, Mattes 1993, Weiss 1993, Otis 1994

Table 23. Fish sampling methods used by fisheries researchers in Grand Canyon.

Sampling Methods	ASU	USFWS	U of A[1]	AGFD	B/W	Past
Trammel/Gill Nets	✓		✓	✓	✓	✓
Hoop Nets	✓	✓	✓	✓	✓	✓
Minnow Traps		✓	✓	✓	✓	
Angling	✓			✓	✓	✓
Seining (Bag/Straight)	✓	✓	✓	✓	✓	✓
Electrofishing (Boat/Backpack)			✓		✓	✓
Dip Nets				✓		
Larval Drift				✓		

[1]Data types determined by Allan 1993, Mattes 1993, Weiss 1993, Otis 1994

COMPATIBILITY OF COMMON ELEMENTS

Although investigators conducted similar kinds of studies, their research objectives, methods, and procedures for collecting, organizing, storing, and analyzing data often differed. For these reasons, much of the data collected by fisheries researchers can be only broadly categorized, rather than individual fields being directly comparable. This section examines more closely those data that can be compared in detail, namely the *Water Quality* and *Fish Capture* information. Individual data fields from different researchers' databases are compared for format and content compatibility, with the goals of database integration and GIS development.

Tables 24 and 25 identify the field names and field descriptions used by the different researchers for *Water Quality* and *Fish Capture* information. Although there are a number of apparent incompatibilities between the different researchers' data formats, most of them can be resolved by a simple translation. For instance, the *Water Quality* information (Table 24) is primarily numeric; the format differences mainly being the number of digits and decimal places used. These numeric data fields can easily be converted into a common format by adopting the largest number of digits and decimal places used by the researchers, and then translating all other fields into this format.

The numeric data fields of the *Fish Capture* information (Table 25) are mostly compatible, with no translation necessary. The non-numeric fields are less compatible, but can be translated into compatible formats, for the most part. Several fields are identical and require no translation (e.g., PIT tag number and weight). There are some incompatibilities between *Fish Capture* fields. For example, there are fields that contain the same information recorded in different ways (e.g., left and right bank location looking upstream or downstream), fields with different formats that record the same information (e.g., date), and fields with common formats, but different codes for the same information (e.g., fish species codes). In each case a single format, set of codes, or way of expressing information can be chosen and the fields that differ can be translated to match.

Data such as location information, however, involve more than a simple translation. This is partly because each researcher records location information differently, but also because river mile and meter locations are often imprecise. This can result in two researchers using different river mile designations for the same location, neither of which are exact. See Table 26 for a description of the river mile and meter standards used by fisheries researchers in Grand Canyon. A GIS can resolve this problem by employing a file with equivalent river miles for the different researchers, or by defining a unique river center line using each researcher's river mile standard. Integrating location information into a field-specific database will be more complex than the field translations described above.

Other than this uncertainty about location information, the *Water Quality* and *Fish Capture* data can be made compatible with relatively straightforward translations. When more information becomes available on the past collections, B/W will examine the limited morphometric/meristic data fields included in that dataset and determine their compatibility with the B/W morphometric/meristic data. Phase II of the GCFIN database will include more detailed discussion of how the Grand Canyon fisheries databases, or partitions of them, can be integrated.

Table 24. Compatibility of water quality fields between databases of fisheries researchers in Grand Canyon.

Information	Researcher	Field Name	Field Description	Field Format
Date	ASU	MONTH; DAY; YEAR	2-digits for each of month, day, year	(MM)(DD)(YY)
	USFWS	DATE	dBase data field	(MM/DD/YY)
	AGFD - LCR			
	AGFD - MC	RUN_MO; RUN_DA; RUN_YR	2-digits for each of month, day, year	(MM)(DD)(YY)
	B/W	DATE	6-character code	(YYMMDD)
Time	ASU	HOUR	4-digit military time	(HHMM)
	USFWS	TIME	4-digit military time	(HHMM)
	AGFD - LCR			
	AGFD - MC	RUN_HR; RUN_MM	2-digit for each of hour and minute	(HH)(MM)
	B/W	TIME	4-digit military time	(HHMM)
Location	ASU			
-Code	USFWS	CAMP	1-character code	(C)
	AGFD - LCR	STUDY	Last 3 digits of field	(999)
	AGFD - MC			
	B/W			
-River	ASU			
	USFWS			
	AGFD - LCR			
	AGFD - MC			
	B/W	RIVER	2-character river or tributary code	(CC)
-River Mile	ASU			
	USFWS			
	AGFD - LCR			
	AGFD - MC			
	B/W	RM	Numeric river mile from Belknap Guide and marked aerial photos	(999.99)
-Meter	ASU			
	USFWS	KM	Kilometers from mouth of LCR	(99999)
	AGFD - LCR			
	AGFD - MC			
	B/W	METER	Meters from mouth of tributary	(9999)
Water Temperature	ASU			
	USFWS	TEMP	3-digit number (°C)	(999)
	AGFD - LCR			
	AGFD - MC	TEMP	2-digit number with 2 decimal places (°C)	(99.99)
	B/W	TEMP	2-digit number with 2 decimal places (°C)	(99.99)
pH	ASU			
	USFWS	PH	4-digit number	(9999)
	AGFD - LCR			
	AGFD - MC	PH	1-digit number with 2 decimal places	(9.99)
	B/W	PH	2-digit number with 2 decimal places	(99.99)

Table 24. Continued.

Information	Researcher	Field Name	Field Description	Field Format
Conductivity	ASU			
	USFWS	COND	4-digit number (ms)	(9999)
	AGFD - LCR			
	AGFD - MC	COND	1-digit number with 3 decimal places	(9.999)
	B/W	COND	2-digit number with 3 decimal places	(99.999)
Dissolved Oxygen	ASU			
	USFWS	DO	4-digit number (ppm)	(9999)
	AGFD - LCR			
	AGFD - MC	DOPERSAT	3-digit number with 1 decimal place (%sat)	(999.9)
		DOMGPERL	2-digit number with 2 decimal places (mg/L)	(99.99)
	B/W	DO	2-digit number with 2 decimal places	(99.99)
Oxidation/Reduction Potential	ASU			
	USFWS	ORP	4-digit number	(9999)
	AGFD - LCR			
	AGFD - MC	REDOX	3-digit number	(999)
	B/W	ORP	2-digit number with 3 decimal places	(99.999)
Salinity	ASU			
	USFWS	SAL	3-digit number (%)	(999)
	AGFD - LCR			
	AGFD - MC	SALINITY	1-digit number with 1 decimal place	(9.9)
	B/W			
Battery Voltage of Instrument	ASU			
	USFWS			
	AGFD - LCR			
	AGFD - MC	VOLTS	3-digit number with 1 decimal place	(999.9)
	B/W	BATT	2-digit number with 2 decimal places	(99.99)
Turbidity -Code	ASU			
	USFWS			
	AGFD - LCR			
	AGFD - MC			
	B/W	TURBIDITY	2-character code	(CC)
-Secchi	ASU			
	USFWS	SECCHI	3-digit number (cm)	(999)
	AGFD - LCR			
	AGFD - MC			
	B/W	SECCHI	1-digit number with 2 decimal places (m)	(9.99)
-Turbidimeter	ASU			
	USFWS	TURBID	5-digit number (NTU)	(99999)
	AGFD - LCR			
	AGFD - MC			
	B/W	NTU	4-digit number with 2 decimal places (NTU)	(9999.99)

Table 25. Compatibility of fish capture fields between databases of fisheries researchers in Grand Canyon.

Information	Researcher	Field Name	Field Description	Field Format
Date	ASU	MONTH; DAY; YEAR	2-digits for each of month, day, year	(MM)(DD)(YY)
	USFWS	DATE	dBase data field	(MM/DD/YY)
	AGFD-LCR	RUN_MO; RUN_DA; RUN_YR	2-digits for each of month, day, year	(MM)(DD)(YY)
	AGFD-MC			
	B/W	DATE	6-character code	(YYMMDD)
Time	ASU	HOUR	4-digit military time	(HHMM)
	USFWS	TIME	4-digit military time	(HHMM)
	AGFD-LCR	RUN_HR; RUN_MM	2-digit for each of hour and minute	(HH)(MM)
	AGFD-MC			
	B/W	TIME	4-digit military time	(HHMM)
Location -Code	ASU	LOCATION	USFWS transect code	(CCC)
	USFWS	ID	Transect code and bank location looking upstream	(CCCCCCCC)
	AGFD-LCR	FWS	USFWS transect code	(CCC)
	AGFD-MC	STUDY	last 3 digits of field	(999)
	B/W			
-River	ASU	WACODE	2-digit AGFD tributary code	(99)
	USFWS			
	AGFD-LCR	REACH	2-digit tributary code	(99)
	AGFD-MC			
	B/W	RIVER	2-character river code	(CC)
-River Mile	ASU			
	USFWS			
	AGFD-LCR			
	AGFD-MC			
	B/W	RM	Numeric river mile from Belknap Guide and marked aerial photos	(999.99)
-Meters	ASU			
	USFWS			
	AGFD-LCR	MILE	Meters from mouth of LCR	(99999.99)
	AGFD-MC			
	B/W	METER	Meters from mouth of tributary	(9999)
-Side	ASU			
	USFWS	ID	Bank location looking upstream	(CCCCCCCC)
	AGFD-LCR	SIDE	Bank location looking ?	(C)
	AGFD-MC			
	B/W	SIDE	Bank location looking downstream	(C)
Species	ASU	SPECIES	2 and 3-character codes	(CC)(CCC)
	USFWS	SPP	3-character codes	(CCC)
	AGFD-LCR	SPECIES	3-character codes	(CCC)
	AGFD-MC	SPECIES	3-character codes	(CCC)
	B/W	SPECIES	2-character codes	(CC)

Table 25. Continued.

Information	Researcher	Field Name	Field Description	Field Format
Length	ASU	LENGTH	4-digit total length in mm	(9999)
	USFWS	LNTH	3-digit total length in mm	(999)
	AGFD-LCR	LENGTH	4-digit total length in mm	(9999)
	AGFD-MC	LENGTH	4-digit total length in mm	(9999)
	B/W	TL; SL	3-digit total length and standard length in mm	(999)(999)
Weight	ASU	WEIGHT	4-digit weight in grams	(9999)
	USFWS	WGHT	4-digit weight in grams	(9999)
	AGFD-LCR	WEIGHT	5-digit weight in grams	(99999)
	AGFD-MC	WEIGHT	4-digit weight in grams	(9999)
	B/W	WT	4-digit weight in grams for natives; 2-digit lb/oz for non-natives	(9999)(99)(99)
Sex	ASU	SEX	1-digit number for unknown, male, female	(9)
	USFWS	SEX	1-character code for male, female	(C)
	AGFD-LCR	SEX	1-character code for male, female, undetermined, not checked	(C)
	AGFD-MC	SEX	1-character code for male, female	(C)
	B/W	SEX	1-character code for male, female, immature, undetermined	(C)
PIT Tag	ASU	TAG	10-character code	(CCCCCCCCCC)
	USFWS	PIT	10-character code	(CCCCCCCCCC)
	AGFD-LCR	TAGNUM	10-character code	(CCCCCCCCCC)
	AGFD-MC	TAG	10-character code	(CCCCCCCCCC)
	B/W	PIT_TAG	10-character code	(CCCCCCCCCC)
Gear Type	ASU	GEAR	1-digit code	(9)
	USFWS	GEAR	3-character code	(CCC)
	AGFD-LCR	GEAR_TYP	2-character code (also fields for height, length, mesh)	(CC)
	AGFD-MC			
	B/W	GEAR	2-character code	(CC)
Habitat	ASU			
	USFWS			
	AGFD-LCR			
	AGFD-MC	HAB_CO	2-character code	(CC)
	B/W			
-Channel	ASU			
	USFWS			
	AGFD-LCR	HABCHANN	2-character code	(CC)
	AGFD-MC			
	B/W	HAB1	2-character code	(CC)

Table 25. Continued.

Information	Researcher	Field Name	Field Description	Field Format
-Primary	ASU			
	USFWS			
	AGFD-LCR	HABTYPE	2-character code	(CC)
	AGFD-MC			
	B/W	HAB2	2-character code	(CC)
-Secondary	ASU			
	USFWS			
	AGFD-LCR	HABTY2	2-character code	(CC)
	AGFD-MC			
	B/W			
-Shoreline	ASU			
	USFWS			
	AGFD-LCR			
	AGFD-MC			
	B/W	HAB3	2-character code	(CC)
Maturity	ASU	MATURITY	1-digit code	(9)
	USFWS	REMARKS	recorded in remarks	
	AGFD-LCR	MATURITY	1-digit code	(9)
	AGFD-MC	MATURITY	1-digit code	(9)
	B/W	RIPE	2-character code	(CC)
Mark/Recapture	ASU			
	USFWS	RECAP	1-character (yes or no)	(C)
	AGFD-LCR	MARK_REC	1-character code (mark or recapture)	(C)
	AGFD-MC	MARK_RECAP	1-character code (mark or recapture)	(C)
	B/W	RECAPTURE	1-character (yes or no)	(C)
Old Tag	ASU	RECAPTURE	10-character field for old tag number	(CCCCCCCCCC)
	USFWS	REMARKS	recorded in remarks	
	AGFD-LCR	OLDTAG	1-character code (yes or no)	(C)
	AGFD-MC			
	B/W	OLD_TAG	10-character field for old tag number	(CCCCCCCCCC)
Other Marks	ASU			
	USFWS	FIN	4-character fin clip code	(CCCC)
	AGFD-LCR			
	AGFD-MC			
	B/W	PIT_TAG; OLD_TAG	clip and punch info recorded in PIT_TAG and OLD_TAG field	(CCCCCCCCC)
Disposition	ASU			
	USFWS			
	AGFD-LCR	DISPOSE	2-character code	(CC)
	AGFD-MC	DISP	2-character code	(CC)
	B/W	DISP	2-character code	(CC)

Table 25. Continued.

Information	Researcher	Field Name	Field Description	Field Format
Parasites	ASU			
	USFWS	REMARKS	recorded in remarks	
	AGFD-LCR	PARASITE	2-digit for number of parasites	(99)
	AGFD-MC			
	B/W	COMMENTS	recorded in comments	
Photo/Video	ASU			
	USFWS			
	AGFD-LCR			
	AGFD-MC			
	B/W	PHOTO_VID	1-character code	(C)

Table 26. River mile and meter standards used by fisheries researchers in Grand Canyon.

Researcher	River Mile/Meter Standard
ASU (Little Colorado River)	USFWS transect code and/or generic site name
USFWS (Little Colorado River)	USFWS transect code
U of A (Tributaries)	Meters measured from tributary mouth
AGFD (Little Colorado River)	USFWS transect code and meters measured from mouth
AGFD (Mainstem Colorado River)	Stevens' River Guide and River miles marked on aerial photos
B/W (Mainstem Colorado River)	Belknap River Guide and River miles marked on aerial photos
Historical and Past Collections	Information not available at this time

LITERATURE CITED

Allan, N.L. 1993. Distribution and abundance of fishes in Shinumo Creek in the Grand Canyon. Master of Science Thesis, University of Arizona. 76 p.

Arizona Game and Fish Department. 1990. Glen Canyon Environmental Studies Phase II Native Fish Studies. A Research Proposal.

Douglas, M.E. and P.C. Marsh. 1990. Ecology and conservation biology of humpback chub, *Gila cypha*, in the Little Colorado River, Arizona. Arizona State University Technical Proposal.

Glen Canyon Environmental Studies. 1990. Draft Integrated Research Plan, Volumes 1 and 2. Bureau of Reclamation, GCES, Flagstaff, AZ.

Gorman, O.T. 1993. U.S. Fish and Wildlife Service stream fish habitat studies operation manual. Glen Canyon Environmental Studies.

Gorman, O.T. 1994. Habitat use by humpback chub, *Gila cypha*, in the Little Colorado River and other tributaries of the Colorado River. Glen Canyon Environmental Studies Phase II Annual Report. Prepared for Glen Canyon Environmental Studies, Flagstaff, AZ. Prepared by U.S. Fish and Wildlife Service, Flagstaff, AZ. 129 p.

Kubly, D.M. 1990. The endangered humpback chub (Gila cypha) in Arizona. A review of past studies and suggestions for future research. Arizona Game and Fish Department. Draft.

Mattes, W.P. 1993. An evaluation of habitat conditions and species composition above, in and below the atomizer falls complex of the Little Colorado River. Master of Science Thesis, University of Arizona. 105 p.

Otis, E.O. 1994. Distribution, abundance, and composition of fishes in Bright Angel and Kanab Creeks, Grand Canyon National Park, Arizona. Master of Science Thesis, University of Arizona. 196 p.

Valdez, R.A., W.J. Masslich, W. Leibfried, A. Wasowicz, B. Cowdell, R. VanHaverbeke, H. Yard, T.M. Trinca, and L.I. Brown. 1992. Characterization of the life history and ecology of the humpback chub in the Grand Canyon. Annual Report to Bureau of Reclamation, Contract No. 0-CS-40-09110. Report no. TR 250-05, BIO/WEST, Inc., Logan, Utah.

Valdez, R.A., and M. Hugentobler (editors). 1993. Characterization of the life history and ecology of the humpback chub (Gila cypha) in the Grand Canyon. Annual Report - 1992 to Bureau of Reclamation, Contract No. 0-CS-40-09110. BIO/WEST Report No. TR-250-06. 168 pp + appendices.

Valdez, R.A. and T. Hougaard. 1993. Grand Canyon Fisheries Integrated Database. BIO/WEST, Inc. Technical Proposal.

Weiss, S.J. 1993. Spawning, movement and population structure of flannelmouth sucker in the Paria River. Master of Science Thesis, University of Arizona. 153 p.

APPENDIX A

DATABASE FILE STRUCTURES

Note:

This appendix contains detailed lists of field contents within each file structure identified from Phase I of this project. Data field types (TYPE) are consistent with dBASE™ definitions:

C = character
N = numeric
D = date
L = logical

A-1. ARIZONA STATE UNIVERSITY FILE STRUCTURES

File: ASU9X (X = 1, 2, 3, etc.)
Contents: Fish collection data

Field	Type	Size	Dec	Description
CAMP	C	1	0	Camp code
TRIP	N	2	0	Trip number
YEARCODE	C	1	0	Year code
WACODE	N	2	0	AGFD reach code: 22=Little Colorado River
LOCATION	C	8	0	USFWS transect code and/or generic site name
GEAR	N	1	0	Gear code
MONTH	N	2	0	Date
DAY	N	2	0	Date
YEAR	N	2	0	Date
METERS	N	7	1	Meters above the mouth
HOUR	N	4	0	Time
SPECIES	C	3	0	Fish species
LENGTH	N	4	0	Total length
WEIGHT	N	4	0	Weight
SEX	N	1	0	Sex code
MATURITY	N	1	0	Maturity code
TAG	C	10	0	Tag number
RECAPTURE	C	10	0	Tag number of recaptured fish

A-2. U.S. FISH AND WILDLIFE SERVICE FILE STRUCTURES

The following field descriptions were extracted from Gorman (1993), and the file names are those of the sample data sets provided by USFWS.

File: **MNH.DBF**
Contents: **USFWS mini-hoop nets**

Field	Type	Size	Dec	Description
GEAR	C	3	0	Gear code
ID	C	8	0	LCR transect and bank location coding
DATE	D	8	0	Date when measured
TIME	C	4	0	Time when measured
SETD	D	8	0	Date set
SETT	C	4	0	Time set
PULD	D	8	0	Date pulled
PULT	C	4	0	Time pulled
LATDS	N	4	0	Lateral distance to set
UPDN	N	4	0	Distance up or downstream of transect
LATP	N	4	0	Lateral distance to nearest bank or edge
MO	N	3	0	Depth of water at mouth of hoop
MTH	N	3	0	Distance below water surface to top of hoop (mouth)
PO	N	3	0	Depth of water at point of net
PTH	N	3	0	Distance below water surface to top of front hoop
T	C	1	0	Transect letter for hoop net habitat meas. grid
P	N	1	0	Point or column number for hoop net hab. meas. grid
EDG	N	3	0	Distance (cm) when <=100 to edge
DPH	N	3	0	Depth (cm)
CUR	N	1	0	Current category
CC	C	2	0	Current comments
SUB	N	2	0	Primary substrate
SBC	C	4	0	Secondary substrate descriptor
OVH	C	4	0	Overhang, vert. edge
CVR	N	2	0	Cover
CCV	N	2	0	Corrected cover

A-2. U.S. Fish and Wildlife Service File Structures - cont.

File: **AHP.DBF**
Contents: **ASU hoop nets**

Field	Type	Size	Dec	Description
GEAR	C	3	0	Gear code
GEARD	C	5	0	Gear description
ID	C	8	0	LCR transect and bank location coding
DATE	D	8	0	Date when measured
TIME	C	4	0	Time when measured
SETD	D	8	0	Date set
SETT	C	4	0	Time set
PULD	D	8	0	Date pulled
PULT	C	4	0	Time pulled
LATDS	N	4	0	Lateral distance to set
UPDN	N	4	0	Distance up or downstream of transect
LATP	N	4	0	Lateral distance to nearest bank or edge
MO	N	3	0	Depth of water at mouth of hoop
MTH	N	3	0	Distance below water surface to top of hoop (mouth)
PO	N	3	0	Depth of water at point of net
PTH	N	3	0	Distance below water surface to top of front hoop
T	C	1	0	Transect letter for hoop net habitat meas. grid
P	N	1	0	Point or column number for hoop net hab. meas. grid
EDG	N	3	0	Distance (cm) when <=100 to edge
DPH	N	3	0	Depth (cm)
CUR	N	1	0	Current category
CC	C	2	0	Current comments
SUB	N	2	0	Primary substrate
SBC	C	4	0	Secondary substrate descriptor
OVH	C	4	0	Overhang, vert. edge
CVR	N	2	0	Cover
CCV	N	2	0	Corrected cover

A-2. U.S. Fish and Wildlife Service File Structures - cont.

File: **TRN.DBF**
Contents: **USFWS transect data**

Field	Type	Size	Dec	Description
KM	N	5	0	Distance in km from Zero Rock (confluence)
M	N	1	0	Indicates 100 transect or other
ID	C	8	0	LCR transect ID
GEAR	C	3	0	Always TRN
DATE	D	8	0	Date transect measured
TIME	N	4	0	Time transect measured
PT	N	3	0	Habitat point number
ELV	N	4	0	Change in elevation of water surface between transects
LATP	N	4	0	Lateral distance to nearest stream bank
EDG	N	2	0	Distance (cm) when <=100 to edge
DPH	N	3	0	Depth (cm)
CUR	N	1	0	Current category
CC	C	2	0	Current comments
SUB	N	2	0	Primary substrate
SBC	C	4	0	Secondary substrate descriptor
OVH	C	4	0	Overhang, vert. edge
CVR	N	2	0	Cover
CCV	N	2	0	Corrected cover

A-2. U.S. Fish and Wildlife Service File Structures - cont.

File: **MTP.DBF**
Contents: **USFWS minnow trap data**

Field	Type	Size	Dec	Description
ID	C	8	0	LCR transect ID, trap number, and bank position arrow
DATE	D	8	0	Date when measured
TIME	C	4	0	Time when measured
GEAR	C	3	0	Always MTP
SETD	D	8	0	Date set
SETT	C	4	0	Time set
PULD	D	8	0	Date pulled
PULT	C	4	0	Time pulled
CNFG	C	4	0	Configuration
LATP	N	4	0	Distance from closest bank to middle of trap
UPDN	N	4	0	Distance up or downstream of transect line
POS	N	3	0	Depth to top of trap
EDG	N	2	0	Distance (cm) when <=100 to edge
DPH	N	3	0	Depth (cm)
CUR	N	1	0	Current category
CC	C	2	0	Current comments
SUB	N	2	0	Primary substrate
SBC	C	4	0	Secondary substrate descriptor
OVH	C	4	0	Overhang, vert. edge
CVR	N	2	0	Cover
CCV	N	2	0	Corrected cover

A-2. U.S. Fish and Wildlife Service File Structures - cont.

File: **FSH.DBF**
Contents: **USFWS fish capture data**

Field	Type	Size	Dec	Description
DATE	D	8	0	Date fish was measured
TIME	C	4	0	Time fish was measured
PER	C	1	0	Period of day fish was measured
ID	C	8	0	LCR transect, bank location, trap/net number
GEAR	C	3	0	Gear code
SPP	C	3	0	Fish species
NUM	N	3	0	Number of fish
LNTH	N	3	0	Length of fish (mm)
WGHT	N	4	0	Weight of fish (g)
SEX	C	1	0	Sex
FIN	C	4	0	Fin clip code for new captures and recaps
PIT	C	10	0	PIT tag number
RECAP	C	1	0	Recapture or new capture
REMARKS	C	20	0	Remarks

File: **WTQ.DBF**
Contents: **USFWS water quality data**

Field	Type	Size	Dec	Description
GEAR	C	3	0	Water quality instrumentation
CAMP	C	1	0	Camp
KM	N	5	0	Kilometers
DATE	D	8	0	Date measured
TIME	N	4	0	Time measured
DHI	N	3	0	Daily high air temperature (°F)
DLO	N	2	0	Daily low air temperature (°F)
AMBT	N	3	0	Present ambient air temperature (°F)
TEMP	N	4	1	Water temperature (°C)
COND	N	4	2	Conductivity (mS)
PH	N	4	2	pH
DO	N	4	1	Dissolved oxygen (ppm)
ORP	N	5	2	Oxidation/reduction potential (hydrolab only)
SAL	N	4	1	Salinity (percent)
SECCHI	N	3	0	Secchi depth (cm)
TURBID	N	5	0	Turbidity (NTUs)
RELEV	N	4	0	Depth of river above base flow (cm)
GAUGE	N	5	1	Reading on staff gauge
CELEV	N	5	0	Corrected river elevation

A-3. UNIVERSITY OF ARIZONA FILE STRUCTURES

File structure information on U of A data are not available at this time. Since these data were collected as part of the USFWS tributary studies, they may be incorporated into the existing USFWS file structures by USFWS.

A-4. ARIZONA GAME AND FISH DEPARTMENT FILE STRUCTURES

Little Colorado River Native Fish Studies

File: **ALGEMAS1.DBF**
Contents: **Algae chlorophyll ('a') analysis data; grids and quarterly, 1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
REACH	N	2	0	Colorado River Reach 22=Little Colorado River
ANALYST	C	3	0	Person who analyzed sample
ANAL_MO	N	2	0	Month analyzed
ANAL_DA	N	2	0	Day analyzed
ANAL_YR	N	2	0	Year analyzed
SET_MO	N	2	0	Month of collection
SET_DA	N	2	0	Day of collection
SET_YR	N	2	0	Year of collection
SET_HR	N	2	0	Hour of collection
SET_MM	N	2	0	Minute of collection
METER	N	5	0	Meter above mouth
SIDE	C	1	0	Side of river: R=right, L=left, C=center
CELL_NO	C	5	0	Sample or cell number
XTR_VOL	N	3	0	Volume of methanol (ml) for chlorophyll extraction
B480	N	5	3	Pre-acidification absorbance, 480 nm, ±.001 nm
B7501	N	5	3	Pre-acidification absorbance, 750 nm, ±.001 nm
B666	N	5	3	Pre-acidification absorbance, 666 nm, ±.001 nm
B7502	N	5	3	Pre-acidification absorbance, 750 nm #2, ±.001 nm
A7501	N	5	3	Post-acidification absorbance, 750 nm, ±.001 nm
A666	N	5	3	Post-acidification absorbance, 666 nm, ±.001 nm
A7502	N	5	3	Post-acidification absorbance, 750 nm #2, ±.001nm
CRUC_NO	N	4	0	Crucible number, used to burn sample
CRUC_WEIGH	N	9	4	Crucible weight, ±.0001 g
DRY_WEIGHT	N	9	4	Dry weight of sample, ±.0001 g
ASH_WEIGHT	N	9	4	Ash weight of sample, ±.0001 g
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

A-4. Arizona Game and Fish Department File Structures - cont.
Little Colorado River Native Fish Studies

File: **ALGAECOL.DBF**
Contents: **Algae and benthos collections (quarterly trips), 1991-1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD Study Number
PAGE	N	3	0	Page of data sheets
MILE	N	5	0	Meters upstream from mouth
SET_MO	N	2	0	Month of collection
SET_DA	N	2	0	Day of collection
SET_YR	N	2	0	Year of collection
SET_HR	N	2	0	Hour of collection
SET_MM	N	2	0	Minute of collection
GEAR_TYP	C	2	0	Gear type code
HABCHAN	C	2	0	Channel type code
HABTYPE	C	2	0	Primary habitat code
SUBS1	C	2	0	Primary substrate code
SUBS2	C	2	0	Secondary substrate code
DISTANCE	N	4	1	Distance from shore (m), to the nearest dm
DEPTH	N	3	0	Depth (cm), to the nearest cm
FLOW	N	5	2	Flow (m/s) ±.015 m/s
AMOUNT	N	2	0	Amount of sample collected (cc), if core sample.
PHOTO_ROLL	N	2	0	Film roll number
PHOTO_NO	N	2	0	Photograph number
SAMP_NO	C	4	0	Sample number
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

File: **QBENTHOS.DBF**
Contents: **Quarterly benthos analysis data, 1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
MILE	N	5	0	Meter above confluence
SET_MO	N	2	0	Month of sample collection
SET_DA	N	2	0	Day of sample collection
SET_YR	N	2	0	Year of sample collection
SET_HR	N	2	0	Hour of sample collection
SET_MM	N	2	0	Minute of sample collection
HABCHAN	C	2	0	Channel type code
HABTYPE	C	2	0	Primary habitat type code
HABTY2	C	2	0	Secondary habitat type code
SIDE	C	1	0	Side of river: R=right, L=left, C=center
SUBS1	C	2	0	Primary substrate code
SUBS2	C	2	0	Secondary substrate code
DISTANCE	N	4	1	Distance from shore (m)
DEPTH	N	3	0	Depth (cm)
FLOW	N	6	2	Current velocity (m/s), ±.01m/s
SAMP_NO	C	3	0	Sample number
ANALYST	C	3	0	Person who analyzed sample
DATE_ANAL	N	6	0	Date analyzed
TAXA	C	3	0	Taxa code
LIFE_STAGE	C	1	0	Life Stage
NO	N	20	2	Number per taxa and life stage
DRY_WEIGHT	N	8	3	Dry weight (g) of sample+crucible, ±.0001g
ASH_WEIGHT	N	8	4	Ash weight (g) of sample+crucible, ±.0001g
CRUC_WGHT	N	8	4	Crucible weight (g), ±.0001g
CRUC_NO	N	8	4	Number assigned to crucible
CHNGDATE	D	8	0	Date record was changed
CHNGTIME	N	4	0	Time record was changed

File: **BEHAVIOR.DBF**
Contents: **Behavioral data, 1991-1993**

Field	Type	Size	Dec	Description
MILE	N	8	0	Meter above mouth
SIDE	C	9	0	Side of river: R=right, L=left, C=center
RUN_MO	N	2	0	Month of observations
RUN_DA	N	2	0	Day of observations
RUN_YR	N	2	0	Year of observations
RUN_HR	N	2	0	Hour of observations
RUN_MM	N	2	0	Minute of observations
SPECIES	C	9	0	Species code
LENGTH	N	8	0	Length interval code (mm)
HABCHAN	C	9	0	Channel type code
HABTYPE	C	5	0	Habitat type code
HM	N	4	0	Hectometer above the mouth
NUM	N	5	0	Number assigned to habitat
POOL_DIM	N	8	0	Pool dimensions (cm^2)
OBSERVER	C	9	0	Observer
AREA	N	8	0	Area covered by fish (cm^2)
CALCIUM	N	8	4	Percent of time feeding on the calcium carbonate
CLAY	N	8	4	Percent of time feeding on the clay
SILT	N	8	4	Percent of time feeding on the silt
SAND	N	8	4	Percent of time feeding on the sand
ROCK	N	8	4	Percent of time feeding on the rock
ALGAE	N	8	4	Percent of time feeding on the algae
MAC	N	8	4	Percent of time feeding on the macrophyte
SURFACE	N	8	4	Percent of time feeding on the surface
COLUMN	N	8	4	Percent of time feeding in the water column
SWIM	N	8	4	Percent of time swimming
SCHOOL	N	8	4	Percent of time schooling
CHASER	N	8	4	Percent of time chasing another fish
CHASEE	N	8	4	Percent of time being chased by another fish
OTHER	N	8	4	Percent of time doing any other behavior
DEPTH	N	8	4	Depth of fish at behavior change (code)
TOTAL	N	8	0	Total percent = 100
TCC	N	8	0	Total seconds feeding in calcium carbonate
TCL	N	8	0	Total seconds feeding in clay
TSI	N	8	0	Total seconds feeding in silt
TSA	N	8	0	Total seconds feeding in sand
TRO	N	8	0	Total seconds feeding in rock
TALG	N	8	0	Total seconds feeding in algae
TMAC	N	8	0	Total seconds feeding in macrophytes
TSUR	N	8	0	Total seconds feeding on the surface
TCOL	N	8	0	Total seconds feeding in the water column
TSWIM	N	8	0	Total seconds swimming
TSCH	N	8	0	Total seconds schooling
TCHER	N	8	0	Total seconds chasing another fish
TCHEE	N	8	0	Total seconds being chased by another fish
TO_	N	8	0	Total seconds doing any other behavior
FCC	N	8	0	Frequency of feeding in calcium carbonate
FCL	N	8	0	Frequency of feeding in clay

A-4. Arizona Game and Fish Department File Structures - cont.
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FSI	N	8	0	Frequency of feeding in silt
FSA	N	8	0	Frequency of feeding in sand
FRO	N	8	0	Frequency of feeding in rock
FALG	N	8	0	Frequency of feeding in algae
FMAC	N	8	0	Frequency of feeding in macrophytes
FSUR	N	8	0	Frequency of feeding on the surface
FCOL	N	8	0	Frequency of feeding in the water column
FSWIM	N	8	0	Frequency of swimming
FSCH	N	8	0	Frequency of schooling
FCHER	N	8	0	Frequency of chasing another fish
FCHEE	N	8	0	Frequency of being chased by another fish
FO	N	8	0	Frequency of doing any other behavior
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

File: **DRFTMAST.DBF**
Contents: **Drift analysis data, quantification of taxa, 1991-1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
MILE	N	5	0	Meter above the mouth
SET_MO	N	2	0	Month net set
SET_DA	N	2	0	Day net set
SET_YR	N	2	0	Year net set
SET_HH	N	2	0	Hour net set
SET_MM	N	2	0	Minute net set
HABCHAN	C	2	0	Channel type code
HABTYPE	C	2	0	Primary habitat type code
HABTY2	C	2	0	Secondary habitat type code
SIDE	C	1	0	Side of river: R=right, L=left, C=center
DISTANCE	N	4	2	Distance from shore (m)
DEPTH	N	3	0	Depth (cm), to the nearest cm
FLOW_INIT	N	4	2	Flow (m/s) at time of net set
FLOW_END	N	4	2	Flow (m/s) at time of net run
SUBSAMPLE	N	1	0	Fraction of sample analyzed, denominator
AMOUNT	N	3	0	Duration of net set, minutes
NUMBER	N	3	0	Sample number
ANALYST	C	3	0	Person who analyzed sample
ANAL_MO	N	2	0	Month analyzed
ANAL_DA	N	2	0	Day analyzed
ANAL_YR	N	2	0	Year analyzed
TAXA	C	3	0	Taxa, a three letter code
LIFE_STAGE	C	1	0	Life stage code
NO	N	4	0	Number counted in subsample
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

A-4. Arizona Game and Fish Department File Structures - cont.
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File: **DRIFTBIO.DBF**
Contents: **Drift biomass data, 1991-1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
MILE	N	5	0	Meter above mouth
SET_MO	N	2	0	Month net set
SET_DA	N	2	0	Day net set
SET_YR	N	2	0	Year net set
SET_HH	N	2	0	Hour net set
SET_MM	N	2	0	Minute net set
HABCHAN	C	2	0	Channel type code
HABTYPE	C	2	0	Primary habitat type code
HABTY2	C	2	0	Secondary habitat type code
SIDE	C	1	0	Side of river: R=right, L=left, C=Center
DISTANCE	N	4	2	Distance from shore (m)
DEPTH	N	3	0	Depth (cm), to the nearest cm
FLOW_INIT	N	4	2	Flow (m/s) at net set
FLOW_END	N	4	2	Flow (m/s) at net pull
SUBSAMPLE	N	1	0	Fraction of sample analyzed, denominator
AMOUNT	N	3	0	Duration of net set (minutes)
NUMBER	N	3	0	Sample number
ANALYST	C	3	0	Person who analyzed sample
ANAL_MO	N	2	0	Month analyzed
ANAL_DA	N	2	0	Day analyzed
ANAL_YR	N	2	0	Year analyzed
DATE	N	6	0	Date analyzed
SAMP_NO	N	3	0	Sample number
SUB_TOP	N	1	0	Subsample fraction, numerator
SUB_BOTT	N	1	0	Subsample fraction, denominator
TAXA	C	3	0	Taxa code, three letters
LIFE_STAGE	C	1	0	Life stage code
NO	N	4	0	Number counted per subsample
TLV	N	4	0	Total volume
SUBVOL	N	3	0	Liquid subsample volume burned
CRUC_WEIGH	N	9	4	Crucible weight (g), ±.0001g
CRUC_NO	N	3	0	Number assigned to specific crucible
DRY_WEIGHT	N	9	4	Dry weight (g), sample+crucible; ±.0001g
ASH_WEIGHT	N	9	4	Ash weight (g), sample+crucible; ±.0001g
ANLYST	C	3	0	Person who burned sample
DATE_BURN	N	6	0	Date burned
VERSION	N	1	0	Version of data set, number for each modification
STATUS	C	2	0	Status of data file; Initials of modifier
CHG_DATE	D	8	0	Date record was changed
CHG_TIME	C	8	0	Time record was changed

A-4. Arizona Game and Fish Department File Structures - cont.
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File: **HABITAT.DBF**
Contents: **Larval fish habitat data (grids), 1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
RUN_MO	N	2	0	Month data recorded
RUN_DA	N	2	0	Day data recorded
RUN_YR	N	2	0	Year data recorded
RUN_TIME	N	4	0	Time data recorded
MILE	N	5	0	Meters above the mouth
SIDE	C	1	0	Side of river: R=right, L=left, C=center
FWS	C	3	0	Fish and Wildlife Service transect number
HABTYPE	C	2	0	Primary habitat type code
FISH	C	1	0	Fish present?: Y=yes, N=no
PHOTOS	C	1	0	Photographs taken?: Y=yes, N=no
ROLL_NO	C	4	0	Film roll number
START_MO	N	2	0	Month began taking pictures
START_DA	N	2	0	Day began taking pictures
START_YR	N	2	0	Year began taking pictures
START_TIME	N	4	0	Time of day began taking pictures
END_MO	N	2	0	Month finished taking pictures
END_DA	N	2	0	Day finished taking pictures
END_YR	N	2	0	Year finished taking pictures
END_TIME	N	4	0	Time of day finished taking pictures
CELL	C	2	0	Grid cell code
TIME_AM	N	4	0	Time in morning that recorded minimum temperature
C_MIN	N	4	1	Minimum temperature (°C)
TIME_PM	N	4	0	Time in afternoon that recorded maximum temp.
C_MAX	N	4	1	Maximum temperature (°C)
VOL_FILTER	N	2	0	Volume of water filtered (ml), zooplankton sample
SUBS1	C	2	0	Primary substrate code
SUBS2	C	2	0	Secondary substrate code
DEPTH	N	5	1	Depth (cm), to the nearest cm
M_SEC	N	5	2	Current velocity (m/s), ±.015 m/s
SEC	N	3	0	Number of seconds it took bead to traverse dist.
FEATURE1	C	2	0	Primary feature code
FEATURE2	C	2	0	Secondary feature code
FEATURE3	C	2	0	Tertiary feature code
FEATURE4	C	2	0	Quaternary feature code
ALGAE	C	1	0	Algae collected: check if yes
COMMENTS	C	30	0	Comments
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

File: **AVAILABL.DBF**
Contents: **Longitudinal habitat availability data, 1992-1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
RUN_MO	N	2	0	Month data recorded
RUN_DA	N	2	0	Day data recorded
RUN_YR	N	2	0	Year data recorded
MILE	N	5	0	Meter above the mouth
SIDE	C	1	0	Side of river: R=Right, L=Left, C=Center
FWS	C	3	0	Fish and Wildlife Service transect number
CM_SHORE	N	4	0	Distance from shore (cm)
DEPTH	N	3	0	Depth (cm)
FLOW	N	5	2	Flow (m/s)
SUBS1	C	2	0	Primary substrate code
SUBS2	C	2	0	Secondary substrate code
FEATURE1	C	2	0	Primary feature code
FEATURE2	C	2	0	Secondary feature code
FEATURE3	C	2	0	Tertiary feature code
FEATURE4	C	2	0	Quaternary feature code
COMMENTS	C	20	0	Comments
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

File: **HABUSE.DBF**
Contents: **Longitudinal habitat use data, 1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
RUN_MO	N	2	0	Month data recorded
RUN_DA	N	2	0	Day data recorded
RUN_YR	N	2	0	Year data recorded
MILE	N	5	0	Meter above the mouth
SIDE	C	1	0	Side of river: R=Right, L=Left, C=Center
FWS	C	3	0	Fish and Wildlife Service transect number
TRANSECT	N	1	0	Transect number
CM_SHORE	N	3	0	Distance from shore (cm)
DEPTH_CM	N	3	0	Depth (cm)
FLOW	N	6	2	Flow (m/s), ±.015 m/s
SUBS1	C	2	0	Primary substrate code
SUBS2	C	2	0	Secondary substrate code
FEATURE1	C	2	0	Primary feature code
FEATURE2	C	2	0	Secondary feature code
FEATURE3	C	2	0	Tertiary feature code
FEATURE4	C	2	0	Quaternary feature code
COLLECT	C	1	0	Collect?: Y=yes, N=no
NO_COLL	N	2	0	Number Collected
HEADSTOM	C	5	0	Sample code
COMMENTS	C	20	0	Comments
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

A-4. Arizona Game and Fish Department File Structures - cont.
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File: **LARVPRES.DBF**
Contents: **Longitudinal survey presence/absence data 1992**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
RUN_MO	N	2	0	Month data recorded
RUN_DA	N	2	0	Day data recorded
RUN_YR	N	2	0	Year data recorded
HM	N	3	0	Hectometer above the mouth
SIDE	C	1	0	Side of river: R=right, L=left, C=center
PRESENCE	C	1	0	Are fish present?: Y=yes, N=no
COLLECT	C	1	0	Collect?: Y=yes, N=no
PRESERVE	C	1	0	Preservative type: E=ethanol, F=formalin
COMMENTS	C	25	0	Comments, includes sample number
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

File: **PRES193.DBF**
Contents: **Longitudinal survey presence/absence data 1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
RUN_MO	N	2	0	Month data recorded
RUN_DA	N	2	0	Day data recorded
RUN_YR	N	2	0	Year data recorded
HM	N	3	0	Hectometer above the mouth
SIDE	C	1	0	Side of river: R=right, L=left, C=center
PRESENCE	C	1	0	Presence or absence: +=present, -=absent
COLLECT_	C	1	0	Fish collected?: Y=yes, N=no
MILE	N	5	0	Meter above mouth that fish was collected
NO_COLLE	N	2	0	Number of fish collected
HEADSTOM	C	5	0	Sample code
COMMENTS	C	25	0	Comments
CHNGDATE	D	8	0	Date record was changed
CHNGTIME	N	4	0	Time record was changed

File: **MAS1FC93.DBF**
Contents: **Fish collections data, 1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
REACH	N	3	0	Colorado River reach, 22=Little Colorado River
LINE	N	3	0	Line of data on data sheet
MILE	N	8	2	Meter upstream from mouth
SIDE	C	1	0	Side of river: L=left, R=right, C=center
FWS	C	3	0	Fish and Wildlife Service transect number
SET_MO	N	2	0	Month net set
SET_DA	N	2	0	Day net set
SET_YR	N	2	0	Year net set
SET_HR	N	2	0	Hour net set
SET_MM	N	2	0	Minute net set
GEAR_TYP	C	2	0	Gear type code
GEAR_H	N	2	0	Gear height (ft), to the nearest ft
GEAR_L	N	3	0	Gear length (ft), to the nearest ft
GEAR_M	N	7	5	Gear mesh (inches), to the hundredths of an inch
SEINE_L	N	7	5	Length of seine haul (m), to nearest m
SEINE_W	N	7	5	Width of seine haul (m), to nearest m
HABCHAN	C	2	0	Channel type code
HABTYPE	C	2	0	Primary habitat type code
HABTY2	C	2	0	Secondary habitat type code
SPECIES	C	3	0	Species code, three letters
LENGTH	N	4	0	Total length of fish (mm), to the nearest mm
WEIGHT	N	5	0	Weight of fish (g), ±1 g
SEX	C	1	0	Sex code
MATURITY	N	1	0	Maturity code
PARASITE	N	2	0	Numbers of parasites (interval code)
TAGNUM	C	0	0	Tag number
MARK_REC	C	1	0	Mark or Recapture: M=mark, R=recapture
OLDTAG	C	1	0	Old tag = floy or carlin, present?: Y=yes, N=no
HEADSTOM	C	5	0	Sample collection code
HEAD_NUM	N	5	0	Head sample number
STOM_NUM	N	5	0	Stomach sample number
DISPOSE	C	2	0	Disposition of fish
RUN_MO	N	2	0	Month that net was run
RUN_DA	N	2	0	Day that net was run
RUN_YR	N	2	0	Year that net was run
RUN_HR	N	2	0	Hour that net was run
RUN_MM	N	2	0	Minute that net was run
COMMENTS	C	25	0	Comments
CHNGDATE	D	8	0	Date record was changed
CHNGTIME	N	4	0	Time record was changed

A-4. Arizona Game and Fish Department File Structures - cont.
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File: **MASTFC92.DBF**
Contents: **Fish collections data, 1992**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheet
REACH	N	3	0	Colorado River reach: 22 = Little Colorado River
LINE	N	3	0	Record line, from data sheet
MILE	N	8	2	Meter above mouth
SIDE	C	1	0	Side of River: R=right, L=left, C=center
FWS	C	3	0	Fish and Wildlife Service transect number
SET_MO	N	2	0	Month net set
SET_DA	N	2	0	Day net set
SET_YR	N	2	0	Year net set
SET_HR	N	2	0	Hour net set
SET_MM	N	2	0	Minute net set
GEAR_TYP	C	2	0	Gear type code
GEAR_H	N	2	0	Gear height (feet), to the nearest ft
GEAR_L	N	3	0	Gear length (feet), to the nearest ft
GEAR_M	N	7	5	Gear mesh (inches), to the hundredth of an inch
SEINE_L	N	7	5	Seine length (m), to the nearest meter
SEINE_W	N	7	5	Seine width (m), to the nearest meter
HABCHAN	C	2	0	Channel type code
HABTYPE	C	2	0	Primary habitat type code
HABTY2	C	2	0	Secondary habitat type code
SPECIES	C	3	0	Species code
LENGTH	N	4	0	Total length (mm)
WEIGHT	N	5	0	Weight (g), ±1g
SEX	C	1	0	Sex code
MATURITY	N	1	0	Maturity code
PARASITE	N	2	0	Numbers of parasites (interval code)
TAGNUM	C	10	0	Tag number
MARK_REC	C	1	0	Mark or recapture?: M=mark, R=recapture
OLDTAG	C	1	0	Old tag (external)?: Y=yes, N=no
HEADSTOM	C	5	0	Sample number
HEAD_NUM	N	5	0	Head (otolith) sample number
STOM_NUM	N	5	0	Stomach sample number
DISPOSE	C	2	0	Disposition
RUN_MO	N	2	0	Month net was run
RUN_DA	N	2	0	Day net was run
RUN_YR	N	2	0	Year net was run
RUN_HR	N	2	0	Hour net was run
RUN_MM	N	2	0	Minute net was run
COMMENTS	C	25	0	Comments
CHNGDATE	D	8	0	Date record was changed
CHNGTIME	N	4	0	Time record was changed

A-4. Arizona Game and Fish Department File Structures - cont.
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File: **MASTFC91.DBF**
Contents: **Fish collections data, 1991**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
REACH	N	3	0	Colorado River Reach: 22= Little Colorado River
LINE	N	3	0	Data line, from data sheet
MILE	N	8	2	Meter above mouth
SIDE	C	1	0	Side of river: R=right, L=left, C=center
FWS	C	3	0	Fish and Wildlife Service transect number
SET_MO	N	2	0	Month net set
SET_DA	N	2	0	Day net set
SET_YR	N	2	0	Year net set
SET_HR	N	2	0	Hour net set
SET_MM	N	2	0	Minute net set
GEAR_TYP	C	2	0	Gear type code
GEAR_H	N	2	0	Gear height (feet), to the nearest ft
GEAR_L	N	3	0	Gear length (feet), to the nearest ft
GEAR_M	N	7	5	Gear mesh (inches), to the hundredths of an inch
SEINE_L	N	7	5	Length of seine haul (m) to the nearest meter
SEINE_W	N	7	5	Width of seine haul (m) to the nearest meter
HABCHAN	C	2	0	Channel type code
HABTYPE	C	2	0	Primary habitat type code
HABTY2	C	2	0	Secondary habitat type code
SPECIES	C	3	0	Species code
LENGTH	N	4	0	Total length of individual (mm)
WEIGHT	N	5	0	Weight of individual (g) ±1g
SEX	C	1	0	Sex code
MATURITY	N	1	0	Maturity code
PARASITE	N	2	0	Number of parasites, interval code
TAGNUM	C	10	0	Tag number
MARK_REC	C	1	0	Mark or recapture?: M=mark, R=recapture
OLDTAG	C	1	0	Old external tag present? Y=yes, N=no
HEADSTOM	C	5	0	Collected sample code
HEAD_NUM	N	5	0	Collected head sample number
STOM_NUM	N	5	0	Collected stomach sample number
DISPOSE	C	2	0	Disposition
RUN_MO	N	2	0	Month net was run
RUN_DA	N	2	0	Day net was run
RUN_YR	N	2	0	Year net was run
RUN_HR	N	2	0	Hour net was run
RUN_MM	N	2	0	Minute net was run
COMMENTS	C	25	0	Comments
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

A-4. Arizona Game and Fish Department File Structures - cont.
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File: **MASTERFC.DBF**
Contents: **Fish collections data, 1991-1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
REACH	N	3	0	Colorado River reach: 22=Little Colorado River
LINE	N	3	0	Line of data on data sheet
MILE	N	8	2	Meter above mouth
SIDE	C	1	0	Side of river: R=right, L=left, C=center
FWS	C	3	0	Fish and Wildlife Service transect number
SET_MO	N	2	0	Month of net set
SET_DA	N	2	0	Day of net set
SET_YR	N	2	0	Year of net set
SET_HR	N	2	0	Hour of net set
SET_MM	N	2	0	Minute of net set
GEAR_TYP	C	2	0	Gear type code
GEAR_H	N	2	0	Gear height (ft)
GEAR_L	N	3	0	Gear length (ft)
GEAR_M	N	7	5	Gear mesh (in)
SEINE_L	N	7	5	Length of seine haul
SEINE_W	N	7	5	Width of seine haul
HABCHAN	C	2	0	Channel type code
HABTYPE	C	2	0	Primary habitat type code
HABTY2	C	2	0	Secondary habitat type code
SPECIES	C	3	0	Species code
LENGTH	N	4	0	Total length (mm)
WEIGHT	N	5	0	Weight (g), ±1g
SEX	C	1	0	Sex code
MATURITY	N	1	0	Maturity code
PARASITE	N	2	0	Number of parasites
TAGNUM	C	0	0	Tag number
MARK_REC	C	1	0	Mark or recapture? M=mark, R=recapture
OLDTAG	C	1	0	Old external tag? Y=yes, N=no
HEADSTOM	C	5	0	Sample code
HEAD_NUM	N	5	0	Head sample code
STOM_NUM	N	5	0	Stomach sample code
DISPOSE	C	2	0	Disposition code
RUN_MO	N	2	0	Month net run
RUN_DA	N	2	0	Day net run
RUN_YR	N	2	0	Year net run
RUN_HR	N	2	0	Hour net run
RUN_MM	N	2	0	Minute net run
COMMENTS	C	25	0	Comments
CHNGDATE	D	8	0	Date of record change
CHNGTIME	N	4	0	Time of record change

A-4. Arizona Game and Fish Department File Structures - cont.
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File: **VISCMAST.DBF**
Contents: **Viscera analysis data, 1988-1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
DATE	N	6	0	Date sample collected
TIME	N	4	0	Time sample collected
STOMNUM	C	4	0	Stomach number
SPECIES	C	3	0	Species code
REACH	N	3	0	Colorado River reach: 22 = Little Colorado River
MILE	N	5	0	Meter above confluence
LENGTH	N	3	0	Total length (mm)
WEIGHT	N	4	0	Weight (g), ±1g
GEAR	C	2	0	Gear type code
SEX	C	1	0	Sex code
TOTGONAD	N	7	2	Total gonad weight
EGGS	N	6	2	Weight per 100 eggs
MAT	N	1	0	Maturity code
PARCODE	C	1	0	Number of parasites (interval code)
COMMENTS	C	30	0	Comments
MEATYPE	C	1	0	Viscera content measurement type
GUTFULL	N	6	2	Initial gut fullness
DATANAL	N	6	0	Date analyzed
BY	C	3	0	Person who performed the analysis
TAXA	C	3	0	Taxonomic code
LIFE	C	1	0	Life stage code
NUMBER	N	4	0	Number of each taxa found in gut
VOLUME	N	6	2	Volume or weight of each taxa in gut
COMMENT2	C	30	0	Comments
STATUS	C	1	0	Status of data file
CHG_DT	D	8	0	Date of record change
CHG_TIME	C	8	0	Time of record change
VERSION	N	2	0	Version of data file

File: **MOVEMAS1.DBF**
Contents: **Larval fish movement data (traps),1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	3	0	Page of data sheets
METER	N	5	0	Meter above mouth
SIDE	C	1	0	Side of river: R=right, L=left, C=center
FWS	C	3	0	Fish and Wildlife Service transect number
HAB_TYPE	C	2	0	Habitat type code
SET_MO	N	2	0	Month trap set
SET_DA	N	2	0	Day trap set
SET_YR	N	2	0	Year trap set
SET_HR	N	2	0	Hour trap set
SET_MM	N	2	0	Minute trap set
RECORDER	C	3	0	Person who recorded data
RUN_MO	N	2	0	Month trap was run
RUN_DA	N	2	0	Day trap was run
RUN_YR	N	2	0	Year trap was run
RUN_HR	N	2	0	Hour trap was run
RUN_MM	N	2	0	Minute trap was run
IN_CATCH	N	3	0	Number of fish caught in the inflow trap
OUT_CATCH	N	3	0	Number of fish caught in the outflow trap
POOLS	N	3	0	Estimated number of fish in pool
DOWN_CATCH	N	3	0	Number of fish caught in downstream facing trap
TRAP_SIZE	C	1	0	Trap size: S=small, L=large
CM5	N	5	2	Current velocity (m/s), 5 cm from shore, ±.015m/s
CM15	N	5	2	Flow (m/s), 15 cm from shore, ±.015 m/s
CM25	N	5	2	Flow (m/s) at 25 cm from shore, ±.015 m/s
CM35	N	5	2	Flow (m/s) at 35 cm from shore, ±.015 m/s
CM45	N	5	2	Flow (m/s) at 45 cm from shore, ±.015 m/s
CM55	N	5	2	Flow (m/s) at 55 cm from shore, ±.015 m/s
DRFT_CHECK	C	1	0	Drift taken? yes indicated as a check
COMMENTS	C	10	0	Comments
CHNGDATE	D	8	0	Date record was changed
CHNGTIME	N	4	0	Time record was changed

File: **FCHABUSE.DBF**
Contents: **Fish collections habitat use data, 1991-1993**

Field	Type	Size	Dec	Description
STUDY	N	5	0	AGFD study number
PAGE	N	4	0	Page of data sheets
BOTTOM	C	2	0	Bottom substrate code
DEPTH	N	4	0	Depth (cm)
FLOW	N	6	2	Current velocity (m/s), ±.01m/s
FEATURE	C	2	0	Cover feature code

A-4. ARIZONA GAME AND FISH DEPARTMENT FILE STRUCTURES

Mainstem Colorado River Native Fish Studies

File: ALLSONDE.DBF
Contents: Data from Hydrolab Datasondes

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
SITE	N	3	0	Site number at that location
MONTH	N	2	0	Date
DAY	N	2	0	Date
YEAR	N	2	0	Date
HOUR	N	2	0	Time of day
MIN	N	2	0	Time of day
TEMP	N	5	2	Temperature (°C)
PH	N	4	2	pH
COND	N	5	3	Conductivity
SALINITY	N	3	1	Salinity
DOPERSAT	N	5	1	Dissolved oxygen (% Saturation)
DOMGPERL	N	5	2	Dissolved oxygen (mg/L)
REDOX	N	3	0	Redox potential
LEVEL	N	4	2	Depth of sonde
VOLTS	N	4	1	Battery strength

File: A_MASTER.DBF
Contents: Type A sample habitat data

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
BY	C	3	0	Initials of data recorder
SITE	N	2	0	Site number at that location
HAB_CD	C	2	0	Habitat code
DEPTH	N	3	0	Depth
VELOCITY	N	3	0	Water velocity (cm/s)
TEMP	N	4	1	Temperature
SUBST_CD	C	2	0	Substrate code
TURB	N	6	0	Turbidity (NTU)
DO_PCNT	N	5	1	Dissolved oxygen (% saturation)
DO_MGL	N	5	2	Dissolved oxygen (mg/L)
COND	N	4	0	Conductivity (microsiemens)
AMB_LITE	C	2	0	Ambient light
PH	N	5	2	pH
GEAR_CD	C	2	0	Gear code
HAULS	N	2	0	Number of hauls taken with that gear
EFFORT	N	7	2	Effort (m^2 for seines or hours for traps)
STATUS	C	1	0	dBase information
CHG_DATE	D	8	0	dBase information
CHG_TIME	C	8	0	dBase information
VERSION	N	2	0	dBase information

A-4. Arizona Game and Fish Studies File Structures - cont.
Mainstem Colorado River Fish Studies

File: **BENTMAST.DBF**
Contents: **Benthos data**

Field	Type	Size	Dec	Description
TRIP_NO	N	2	0	Trip number
PAGE	N	3	0	Page number of data sheet
OFPAGE	N	3	0	Total number of pages
STUDY	N	5	0	Study number: trip and location numbers
SITE	C	5	0	Site number at that location
TAXA	C	9	0	Taxa of organism
NUMBER	N	5	0	Number of that taxa counted
CRUC_NO	N	3	0	Crucible number
CRUC_WGHT	N	8	4	Crucible weight
DRY_WEIGHT	N	8	4	Dry weight of organisms
ASH_WEIGHT	N	8	4	ash weight of organisms

File: **DIET_ANA.DBF**
Contents: **Fish diet analysis (stomach samples)**

Field	Type	Size	Dec	Description
STUDY	C	5	0	Study number: trip and location numbers
HAB_CD	C	2	0	Habitat code
SPECIES	C	3	0	Fish species
LENGTH	N	3	0	Total length
TAXA	C	3	0	Taxa of food organism
LIFE_STAGE	C	1	0	Life stage of food organism
NUMBER	N	4	0	Number of food organism counted
PARASITE	C	1	0	Parasitic: Y or N
NOTES	C	30	0	Descriptive notes

A-4. Arizona Game and Fish Studies File Structures - cont.
Mainstem Colorado River Fish Studies

File: **FISH_ALL.DBF**
Contents: **Fish capture data**

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
SITE	N	3	0	Site number at that location
HAB_CD	C	2	0	Habitat code
HAUL_NO	N	3	0	Haul number
SPECIES	C	3	0	Fish species
LENGTH	N	4	0	Total length
WEIGHT	N	4	0	Weight
NO_COLL	N	3	0	Number collected
SEX	C	1	0	Sex
MATURITY	N	1	0	Maturity code
TAG	C	10	0	Type of mark or tag number (if marked or tagged)
MARK_RECAP	C	1	0	Mark or recapture (if tagged)
DISP	C	2	0	Disposition
STATUS	C	1	0	dBase information
CHG_DATE	D	8	0	dBase information
CHG_TIME	C	8	0	dBase information
VERSION	N	2	0	dBase information

A-4. Arizona Game and Fish Studies File Structures - cont.
Mainstem Colorado River Fish Studies

File: **MAP.DBF**
Contents: **Plane table mapping data**

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
NUMBR_SITE	C	3	0	Site number and habitat code
BM_H20	N	3	0	Benchmark to water elevation
DEEP_PT	N	3	0	Maximum depth
TOT_PERIM	N	6	1	Total perimeter length
NET_LNGTH	N	5	1	Width of backwater at net location
AREA_TOT	N	6	1	Total area
AREA_25	N	6	1	Area < 25 cm deep
AREA_25_50	N	6	1	Area > 25 cm and < 50 cm deep
AREA_50_1	N	6	1	Area > 50 cm and < 100 cm deep
AREA_10_15	N	6	1	Area > 100 cm and < 150 cm deep
AREA_15	N	6	1	Area > 15 cm deep
SILT	N	6	1	Area with predominantly silt substrate
SAND	N	6	1	Area with predominantly sand substrate
GRAVEL	N	6	1	Area with predominantly gravel substrate
PEBBLE	N	6	1	Area with predominantly pebble substrate
COBBLE	N	6	1	Area with predominatly cobble substrate
BOULDER_LD	N	6	1	Area with boulder or ledge substrate
TERR_VEG	N	6	1	Area with terrestrial vegetation
RT_AQ_VEG	N	6	1	Area with rooted aquatic vegetation

A-4. Arizona Game and Fish Studies File Structures - cont.
Mainstem Colorado River Fish Studies

File: **MAST_ALL.DBF**
Contents: **Master data sheet data**

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
SITES	N	3	0	Site number at that location
MILE	N	6	2	River mile: distance from Lee's Ferry
SIDE	C	1	0	Side of the river (L or R) when facing downstream
REACH	N	3	0	Reach number
MST_MO	N	2	0	Month
MST_DA	N	2	0	Day
MST_YR	N	2	0	Year
MST_HR	N	2	0	Hour
MST_MM	N	2	0	Minute
FLOWCD	C	2	0	Flow code
FLOW	N	5	0	Estimated flow (cfs)
TYPE_A	N	2	0	Type A sample taken
TYPE_B	N	2	0	Type B sample taken
ANGLING	N	2	0	Angling sample taken
OPPORTUN	N	2	0	Opportunistic sample taken
SONDE	N	2	0	DataSonde set
BENTHOS	N	2	0	Benthos sample taken
SEDIMENT	N	2	0	Sediment sample taken
CHLOROPYLL	N	2	0	Chlorophyll sample taken
PLANKTON	N	2	0	Plankton sample taken
MAP_TOTAL	N	2	0	Total station map drawn
MAP_PLANE	N	2	0	Plane table map drawn
VISCERA	N	2	0	Viscera sample taken
DRIFT	N	2	0	Drift sample taken
TYPE_A2ND	N	2	0	Type A secondary sample taken
FISHCOLL	N	4	0	Total number of fish collected
STATUS	C	1	0	dbase information
CHG_DATE	D	8	0	dbase information
CHG_TIME	C	8	0	dbase information
VERSION	N	2	0	dbase information

A-4. Arizona Game and Fish Studies File Structures - cont.
Mainstem Colorado River Fish Studies

File: **OPP_ALL.DBF**
Contents: **Opportunistic sampling data**

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
BY	C	3	0	Initital of data recorder
SITE	N	2	0	Site number at that location
HAB_CD	C	2	0	Habitat code
DEPTH	N	3	0	Depth (cm)
VELOCITY	N	3	0	Water veleocity (cm/s)
TEMP	N	4	1	Temperature (°C)
SUBST_CD	C	2	0	Substrate code
TURB	N	6	0	Turbidity (NTU)
DO_PCNT	N	6	2	Dissolved oxygen (% saturation)
DO_MGL	N	5	2	Dissolved oxygen (mg/L)
COND	N	4	0	Conductivity (microsiemen)
AMB_LITE	C	2	0	Ambient light
GEAR_CD	C	2	0	Gear code
LENGTH	N	3	0	Length of net
HEIGHT	N	4	1	Height of net
MESH	N	7	5	Mesh size of net
EFFORT	N	7	2	Effort (m^2 for seines or hours for traps)
SET_TIME	N	4	0	Trap set time
END_TIME	N	4	0	Trap check time
DISTANCE	N	5	0	Distance upstream from mainstem (tributaries only)
SITE_L	N	6	2	Site length
SITE_W	N	6	2	Mean site width
SITE_D	N	6	2	Mean site depth
PH	N	5	2	pH
STATUS	C	1	0	dbase information
CHG_DATE	D	8	0	dbase information
CHG_TIME	C	8	0	dbase information
VERSION	N	2	0	dbase information

File: **PLANKTON.DBF**
Contents: **Plankton data**

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
HAB_CD	C	3	0	Habitat code
SUBSAMPLE	N	1	0	Subsample number
MAG	N	3	0	Microscope magnification used
ROW	N	1	0	Row number on counting slide
TAXA	C	3	0	Taxa of plankton organism
TOTAL	N	3	0	Total number counted of that taxa

File: **PRB3.DBF**
Contents: **Type B sample habitat data**

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
SITE	N	3	0	Site number at that location
TRAP_NUM	N	2	0	Minnow trap number
CHK_MO	N	2	0	Month
CHK_DA	N	2	0	Day
CHK_YR	N	2	0	Year
CHK_HR	N	2	0	Hour
CHK_MM	N	2	0	Minute
HAB_CD	C	2	0	Habitat code at time of trap check
SUBST_CD	C	2	0	Substrate code
TEMP	N	5	2	Temperature
FLOW_CD	C	2	0	Flow code
FLOW_CFS	N	5	0	Estimate flow (cfs)
DEPTH	N	3	0	Depth (cm)
VELOCITY	N	4	2	Water velocity (cm/s)
NUM_FISH	N	3	0	Number of fish caught

File: **SEDIMENT.DBF**
Contents: **Sediment data**

Field	Type	Size	Dec	Description
STUDY	N	5	0	Study number: trip and location numbers
HABITAT	C	3	0	Habitat code and site number
HAB_CD	C	2	0	Habitat code
CRU_WT	N	9	4	Crucible weight
DRY_WT	N	9	4	Dry weight of sediments
ASH_WT	N	9	4	Ash weight of sediments
PET_WT	N	9	4	Petri dish weight
PET_65	N	9	4	Weight of sediments > 65 µm

A-5. BIO/WEST, INC. FILE STRUCTURES

File: CHUB.DBF
Contents: Humpback chub morphometrics and meristics, Oct 1990-Nov1993

Field	Type	Size	Dec	Description
PIT_TAG	C	10	0	PIT tag number
DATE	C	6	0	Date (year,month,day)
RIVER	C	2	0	River or tributary code
METER	N	4	0	Meters above tributary mouth (±20m)
TYPE	C	1	0	Type of sample
GEAR	C	2	0	Gear code
SAMPLE_NUM	C	3	0	Sample number
TRIP	C	5	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard number
TL	N	3	0	Total length (mm)
FL	N	3	0	Fork length (mm)
SL	N	3	0	Standard length (mm)
WT	N	4	0	Weight (g), ±1g
SEX	C	1	0	Sex code
RIPE	C	3	0	Gonadal maturity code
P1_P2	N	4	1	Distance between insertions of pectoral and pelvic fins (mm)
ND	N	4	1	Nuchal depression depth (mm)
CPL	N	5	1	Caudal peduncle length (mm)
CPMAXD	N	4	1	Maximum caudal peduncle depth (mm)
CPMIND	N	4	1	Minimum caudal peduncle depth (mm)
HEAD_LN	N	4	1	Head length (mm)
SNOUT_LN	N	4	1	Snout length (mm)
DORSAL_FB	N	4	1	Dorsal fin base (mm)
ANAL_FB	N	4	1	Anal fin base (mm)
BODY_DEPTH	N	5	1	Body depth (mm)
DORSAL_RAY	N	2	0	Number of dorsal fin rays
ANAL_RAY	N	2	0	Number of anal fin rays
RECAPTURE	C	1	0	Recaptured fish
OLD_TAG	C	10	0	Old tag number if fish is recapture
DISP	C	2	0	Disposition code
CAMERA_NUM	C	2	0	Camera number
ROLL_NUM	C	2	0	Roll number
FRAME_NUM	C	5	0	Frame numbers
VIDEO_NUM	C	2	0	Video number
RM_CAPTURE	N	6	2	River mile of capture location (to 1/20 rm)
RM_RELEASE	N	6	2	River mile of release location (to 1/20 rm)
RADIO	C	1	0	Radio-tagged fish
COMMENTS	C	60	0	Comments

File: NET_MC.DBF
Contents: Netting and trapping sample data, Oct 1990-Nov 1993 (humpback chub)
File: NET_HU.DBF
Contents: Netting and trapping sample data, May 1992-Dec 1994 (Hualapai)

Field	Type	Size	Dec	Description
TYPE	C	1	0	Type of sample
TRIP	C	5	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard number
DATE	C	6	0	Date (year,month,day)
RIVER	C	2	0	River or tributary code
RM	N	6	2	River mile (to 1/20 rm)
METER	N	4	0	Meters above tributary mouth (±20m)
GEAR	C	2	0	Gear code
HAB1	C	2	0	General habitat
HAB2	C	2	0	Specific habitat
HAB3	C	2	0	Shoreline habitat
SIDE	C	1	0	Side of river looking downstream
PROFILE	C	1	0	Cross-section fathometer profile status
MAX_DEPTH	N	4	1	Maximum depth at gear location (m)
SUB1	C	2	0	Dominant substrate
SUB2	C	2	0	Secondary substrate
FISH_PRES	C	1	0	Fish or other materials preserved
NO_BOTTLES	N	1	0	Number of bottles with preserved materials
CAMERA_NUM	C	2	0	Camera number
PHOTO_ROLL	C	2	0	Roll number
FRAME_NUM	C	5	0	Frame numbers
CREW	C	8	0	Initials of crew members
SINGLE	C	1	0	Marks one of multiple records for a sample
SAMPLE_NUM	C	3	0	Sample number
TIME_SET	N	4	0	Net set time
TIME_PULL	N	4	0	Net pull time
END_DATE	C	6	0	Net pull date (year,month,day)
TIME_ELAPS	N	5	2	Elapsed time
LIGHT	C	2	0	Ambient light
WEATHER	C	2	0	Weather
TURBIDITY	C	2	0	Turbidity
TEMP_AIR	N	4	1	Air temperature (°C)
TEMP_MC	N	4	1	Main channel temperature (°C)
TEMP_HAB	N	4	1	Habitat temperature (°C)
FLUCT	C	2	0	River stage change
SPECIES	C	2	0	Fish species code
YOY	N	4	0	Number of young-of-year fish
JUV	N	4	0	Number of juvenile fish
ADU	N	4	0	Number of adult fish
TOTAL	N	4	0	Total number of fish
COMMENTS	C	0	0	Comments
MAP_ID_NUM	C	4	0	Unique net location ID to link with GIS

File: **ELEC_MC.DBF**
Contents: **Electrofishing sample data, Oct 1990-Nov 1993 (humpback chub)**
File: **ELEC_HU.DBF**
Contents: **Electrofishing sample data, May 1992-Dec 1994 (Hualapai)**

Field	Type	Size	Dec	Description
TYPE	C	1	0	Type of sample
SAMPLE_NUM	C	3	0	Sample number
TRIP	C	5	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard
DATE	C	6	0	Date (year,month,day)
RIVER	C	2	0	River or tributary code
START_RM	N	6	2	River mile at start of sample (to 1/20 rm)
END_RM	N	6	2	River mile at end of sample (to 1/20 rm)
METER	N	4	0	Meters above tributary mouth (±20m)
TIME_START	N	4	0	Sample start time
TIME_END	N	4	0	Sample end time
SECONDS	N	5	0	Seconds electrofished
VOLTS	N	3	0	Voltage setting
AMPS	N	4	1	Amperage level
LIGHT	C	2	0	Ambient light
HAB1	C	2	0	General habitat
HAB2	C	2	0	Specific habitat
HAB3	C	2	0	Shoreline habitat
SUB1	C	2	0	Dominant substrate
SUB2	C	2	0	Secondary substrate
TEMP_AIR	N	4	1	Air temperature (°C)
TEMP_MC	N	4	1	Main channel temperature (°C)
TEMP_HAB	N	4	1	Habitat temperature (°C)
TURBIDITY	C	2	0	Turbidity
WEATHER	C	2	0	Weather
FLUCT	C	2	0	River stage change
FISH_PRES	C	1	0	Fish or other materials preserved
NO_BOTTLES	N	1	0	Number of bottles of preserved materials
CAMERA_NUM	C	2	0	Camera number
PHOTO_ROLL	C	2	0	Roll number
FRAME_NUM	C	5	0	Frame number
CREW	C	8	0	Initials of crew members
SINGLE	C	1	0	Marks one of multiple records for a sample
SPECIES	C	2	0	Fish species code
YOY	N	4	0	Number of young-of-year fish
JUV	N	4	0	Number of juvenile fish
ADU	N	4	0	Number of adult fish
TOTAL	N	4	0	Total number of fish
COMMENTS	C	60	0	Comments

File: SEIN_MC.DBF
Contents: Seining sample data, Oct 1990-Nov 1993 (humpback chub)
File: SEIN_HU.DBF
Contents: Seining sample data, May 1992-Dec 1994 (Hualapai)

Field	Type	Size	Dec	Description
TYPE	C	1	0	Type of sample
SAMPLE_NUM	C	3	0	Sample number
TRIP	C	5	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard number
DATE	C	6	0	Date (year,month,day)
RIVER	C	2	0	River or tributary code
RM	N	7	2	River mile (to 1/20 rm)
METER	N	4	0	Meters above tributary mouth (±20m)
GEAR	C	2	0	Gear code
TIME_START	N	4	0	Sample start time
HAB1	C	2	0	General habitat
HAB2	C	2	0	Specific habitat
HAB3	C	2	0	Shoreline habitat
SUB1	C	2	0	Dominant substrate
SUB2	C	2	0	Secondary substrate
TEMP_AIR	N	4	1	Air temperature (°C)
TEMP_MC	N	4	1	Main channel temperature (°C)
TEMP_HAB	N	4	1	Habitat temperature (°C)
QUANT	C	1	0	Quantitative seine haul
SUBSAMPL	C	1	0	Subsampled habitat
LIGHT	C	2	0	Ambient light
WEATHER	C	2	0	Weather
TURBIDITY	C	2	0	Turbidity
FLUCT	C	2	0	River stage change
HABL	N	5	1	Habitat length (m)
HABW	N	5	1	Habitat width (m)
SAMP_LN	N	5	1	Sample length (m)
SAMP_WID	N	5	1	Sample width (m)
SAMP_AREA	N	7	2	Sample area (m^2)
MAX_DEPTH	N	4	1	Maximum depth of habitat (ft)
DEPTH_1	N	4	1	Depth halfway between max and one side (ft)
DEPTH_2	N	4	1	Depth halfway between max and other side (ft)
FISH_PRES	C	1	0	Fish or other materials preserved
NO_BOTTLES	N	1	0	Number of bottles of preserved materials
CAMERA_NUM	C	2	0	Camera number
PHOTO_ROLL	C	2	0	Roll number
FRAME_NUM	C	5	0	Frame number
CREW	C	8	0	Initials of crew members
SINGLE	C	1	0	Marks one of multiple records for a sample
SPECIES	C	2	0	Fish species code
LAR	N	4	0	Number of larval fish
YOY	N	4	0	Number of young-of-year fish
JUV	N	4	0	Number of juvenile fish
ADU	N	4	0	Number of adult fish
TOTAL	N	4	0	Total number of fish
COMMENTS	C	60	0	Comments

File: **FISH_MC.DBF**
Contents: **All fish capture data, Oct 1990-Nov 1993 (humpback chub)**
File: **FISH_HU.DBF**
Contents: **All fish capture data, May 1992-Dec 1994 (Hualapai)**

Field	Type	Size	Dec	Description
TYPE	C	1	0	Type of sample
SAMPLE_NUM	C	3	0	Sample number
TRIP	C	5	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard
DATE	C	6	0	Date (year,month,day)
GEAR	C	2	0	Gear code
HAB1	C	2	0	General habitat
HAB2	C	2	0	Specific habitat
HAB3	C	2	0	Shoreline habitat
SUB1	C	2	0	Dominant substrate
SUB2	C	2	0	Secondary substrate
SPECIES	C	2	0	Fish species code
TL	N	3	0	Total length (mm)
SL	N	3	0	Standard length (mm)
LB	N	2	0	Pounds
OZ	N	2	0	Ounces
WT	N	4	0	Weight (g), ±1g
PIT_TAG	C	10	0	PIT tag number
RECAPTURE	C	1	0	Recaptured fish
OLD_TAG	C	10	0	Old tag number if fish is recapture
PHOTO	C	1	0	Photographs taken
VIDEO	C	1	0	Video footage taken
SEX	C	1	0	Sex
RIPE	C	2	0	Gonadal maturity code
DISP	C	2	0	Disposition code
RIVER	C	2	0	River or tributary code
RM	N	6	2	River mile of capture location (to 1/20 rm)
METER	N	4	0	Meters above mouth of tributary (±20m)
RM_RELEASE	N	6	2	River mile of release location (to 1/20 rm)
COMMENTS	C	60	0	Comments

File: **SURVEIL.DBF**
Contents: **Radiotelemetry surveillance, Oct 1990-Nov 1992**

Field	Type	Size	Dec	Description
SAMPLE_NUM	C	3	0	Sample number
TRIP_NUM	C	2	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard number
SINGLE	C	1	0	Marks one of multiple records for a sample
MODE	C	2	0	Type of surveillance
START_DATE	N	6	0	Date at start of surveillance (year,month,day)
START_TIME	N	4	0	Time at start of surveillance
END_DATE	N	6	0	Date at end of surveillance (year,month,day)
END_TIME	N	4	0	Time at end of surveillance
TIME_ELAPS	N	6	2	Time elapsed during surveillance
START_RMI	N	5	1	Starting river mile of surveillance (to 1/20 rm)
END_RMI	N	5	1	Ending river mile of surveillance (to 1/20 rm)
LIGHT	C	2	0	Ambient light
WEATHER	C	2	0	Weather code
TURBIDITY	C	1	0	Turbidity code
SECHI_DISK	N	4	2	Secchi depth (m)
NTU	N	6	1	Turbidity (NTU)
FLUCT	C	2	0	River stage change during surveillance
CREW	C	8	0	Initials of crew members
DATE	N	6	0	Date of individual fish contact (year,month,day)
TIME	N	4	0	Time of individual fish contact
RIVER	C	2	0	River or tributary code
RM	N	6	2	River mile (to 1/20 rm)
SIDE	C	1	0	Side of river looking downstream
FREQ	N	3	0	Tag frequency (40.XXX MHz)
PULSE	N	3	0	Tag pulse rate (pulses/minute)
CONFIDENCE	C	1	0	Observer confidence in location accuracy
HAB2	C	2	0	Specific habitat
COVER	C	2	0	Instream cover
PIT_TAG	C	10	0	PIT tag number
COMMENTS	C	75	0	Comments

File: **OBSERV_H.DBF**
Contents: **Header for radiotelemetry observations, Oct 1990-Nov 1992**

Field	Type	Size	Dec	Description
SAMPLE_NUM	C	3	0	Sample number
TRIP_NUM	C	2	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard number
SINGLE	C	1	0	Marks one of multiple records for a sample
START_DATE	N	6	0	Date at start of observation (year,month,day)
START_TIME	N	4	0	Time at start of observation
END_DATE	N	6	0	Date at end of observation (year,month,day)
END_TIME	N	4	0	Time at end of observation
TIME_ELAPS	N	6	0	Time elapsed during observation
RIVER	C	2	0	River or tributary code
RM	N	6	2	River mile (to 1/20 rm)
MODE	C	2	0	Mode of observation
HAB_MAP_NO	C	10	0	Habitat map number
BENCHMARK	C	6	0	Temporary benchmark code
CONFIDENCE	N	1	0	Observer confidence in location accuracy
CAMERA_NUM	C	2	0	Camera number
PHOTO_ROLL	C	2	0	Roll number
FRAME_NUM	C	5	0	Frame numbers
CREW	C	8	0	Initials of crew members
PIT_TAG	C	10	0	PIT tag number
TL	N	3	0	Total length when implanted (mm)
WT	N	4	0	Weight when implanted (g), ±1g
SEX	C	1	0	Sex
TAG_SIZE	N	2	0	Weight of tag (g)
FREQ_1	N	3	0	Original tag frequency
FREQ_2	N	3	0	Strongest tag frequency observed
PULSE_1	N	2	0	Original tag pulse rate
PULSE_2	N	2	0	Tag pulse rate during observation
SURGEON	C	2	0	Initials of surgeon

A-5. BIO/WEST, Inc. File Structures - cont.

File: OBSERV_M.DBF
Contents: Movement for radiotelemetry observations, Oct 1990-Nov 1992

Field	Type	Size	Dec	Description
SAMPLE_NUM	C	3	0	Sample number
TRIP	C	5	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard number
SINGLE	C	1	0	Marks one of multiple records for a sample
PIT_TAG	C	10	0	PIT tag number
START_DATE	N	6	0	Date at start of observation block (year,month,day)
START_TIME	N	4	0	Time at start of observation block
START_RMI	N	6	2	River mile location at start of observation block (to 1/20 rm)
START_HAB	C	2	0	Specific habitat at start of observation block
START_GAGE	N	5	1	River stage at start of observation block
START_LITE	C	2	0	Ambient light at start of observation block
START_WEAT	C	2	0	Weather code at start of observation block
START_TURB	C	2	0	Turbidity code at start of observation block
END_DATE	N	6	0	Date at end of observation block (year,month,day)
END_TIME	N	4	0	Time at end of observation block
END_RMI	N	6	2	River mile location at end of observation block (to 1/20 rm)
END_HAB	C	2	0	Specific habitat at end of observation block
MOVEMENT	N	3	0	Movement during observation block (m)
END_GAGE	N	5	1	River stage at end of observation block
END_LITE	C	2	0	Ambient light at end of observation block
END_WEAT	C	2	0	Weather code at end of observation block
END_TURB	C	2	0	Turbidity code at end of observation block
TIME_ELAPS	N	6	2	Time elapsed during observation block
GAGE	N	6	1	River stage change during observation block (cm)
STAGE_RATE	N	7	2	Rate of river stage change (cm/hr)

File: REMOTE.DBF
Contents: Remote radiotelemetry station data, Oct 1990-Nov 1993

Field	Type	Size	Dec	Description
JUL_DATE	N	3	0	Julian date
TIME	N	4	0	Time
FREQ	N	3	0	Tag frequency (40.XXX MHz)
PULSE	N	3	0	Tag pulse rate (pulses/minute)

File: DRIFT_MC.DBF
Contents: Drift net sample analysis data, Oct 1990-Nov 1993 (humpback chub)
File: DRIFT_HU.DBF
Contents: Drift net sample analysis data, May 1992-Dec 1994 (Hualapai)

Field	Type	Size	Dec	Description
DATE	N	6	0	Date of sample (year,month,day)
TIME	N	4	0	Time of sample
RM	C	5	0	River mile (to 1/20 rm)
STAGE	C	2	0	River stage change
HAB	C	2	0	Habitat
DEPTH	C	3	0	Height of net above water surface (cm)
SIMADU	N	7	2	Number of adult simuliids
SIMPUP	N	7	2	Number of pupa simuliids
SIMLAR	N	7	2	Number of larval simuliids
CHIRADU	N	7	2	Number of adult chironomids
CHIRPUP	N	7	2	Number of pupa chironomids
CHIRLAR	N	7	2	Number of larval chironomids
GAMMADU	N	7	2	Number of adult gammarus (>7mm)
GAMMIMM	N	7	2	Number of immature gammarus (<7mm)
OTHER	N	7	2	Number of other aquatic invertebrates
TERR	N	7	2	Number of terrestrial insects
CLADDRWT	N	7	4	Cladophora dry weight (g)
CLADPER	N	2	0	Percent cladophora
LABVOL	N	3	0	Sample volume after preservation (ml)
FIELDVOL	N	3	0	Sample volume before preservation (ml)
REHYDVOL	N	3	0	Sample volume after rehydration in lab (ml)
CMH	N	7	2	Water filtered through net (Cubic meters per hour)
NOTES	C	100	0	Specific notes about sample

File: **FOOD.DBF**
Contents: **Stomach pumping analysis data, 1993**

Field	Type	Size	Dec	Description
TYPE	C	1	0	Type of sample
SAMPLE_NUM	C	3	0	Sample number
TRIP	C	5	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
CLIPBOARD	C	1	0	Clipboard
DATE	N	6	0	Date of sample (year,month,day)
RIVER	C	2	0	River or tributary code
RM	N	5	1	River mile (to 1/20 rm)
SPECIES	C	3	0	Species of fish stomach pumped
AGE	C	2	0	Age of fish (adult or juvenile)
SEX	C	1	0	Sex
TL	N	3	0	Total length (mm)
SL	N	3	0	Standard length (mm)
LB	N	3	0	Weight in pounds
OZ	N	3	0	Weight in ounces
WT	N	4	0	Weight in grams
PIT_TAG	C	10	0	PIT tag number
GAMMADU	N	3	0	Number of adult gammarus (>7mm)
GAMMIMM	N	3	0	Number of immature gammarus (<7mm)
SIMADU	N	3	0	Number of adult simulilids
SIMLARV	N	3	0	Number of larval simulilids
SIMPUP	N	3	0	Number of pupa simulilids
CHIRADU	N	3	0	Number of adult chironomids
CHIRPUP	N	3	0	Number of pupa chironomids
CHIRLAR	N	3	0	Number of larval chironomids
ANNELID	N	3	0	Number of annelids
OTHER	N	3	0	Number of other aquatic insects
TERR	N	3	0	Number of terrestrial insects
CLADOVOL	N	3	0	Volume of cladophora (ml)
NEMOTODES	L	1	0	Presence of nematodes
TAPEWORMS	L	1	0	Presence of tapeworms
FISH	L	1	0	Presence of fish
MEMO	C	200	0	Details of sample

File: DSOND_MC.DBF
Contents: Datasonde water quality data, Oct 1990-Nov 1993 (humpback chub)
File: DSOND_MC.DBF
Contents: Datasonde water quality data, May 1992-Dec 1994 (Hualapai)

Field	Type	Size	Dec	Description
DATE	N	6	0	Date (year,month,day)
TIME	N	4	0	Military time
RIVER	C	2	0	River or tributary code
RM	N	6	2	River mile (to 1/20 rm)
TEMP	N	5	2	Temperature (°C)
PH	N	5	2	pH
COND	N	6	3	Conductivity
DO	N	5	2	Dissolved oxygen
BATT	N	5	2	Battery voltage

File: SURV_MC.DBF
Contents: Surveyor II water quality data, Oct 1990-Nov 1993 (humpback chub)
File: SURV_HU.DBF
Contents: Surveyor II water quality data, May 1992-Dec 1994 (Hualapai)

Field	Type	Size	Dec	Description
DATE	N	6	0	Date (year,month,day)
TIME	N	4	0	Military time
RIVER	C	2	0	River or tributary code
RM	N	6	2	River mile (to 1/20 rm)
TEMP	N	5	2	Temperature (°C)
PH	N	5	2	pH
TRUEDO	N	5	2	Dissolved oxygen
COND	N	6	3	Conductivity
ORP	N	6	3	Oxidation-reduction potential
BATT	N	5	2	Battery voltage

File: **JUVHAB.DBF**
Contents: **Juvenile habitat measurements, Oct 1990-Nov 1993**

Field	Type	Size	Dec	Description
SAMPLE_NUM	C	3	0	Sample number
TRIP	C	5	0	Trip code
REACH	C	1	0	Mainstem Colorado River reach code
DATE	N	6	0	Date (year,month,day)
RIVER	C	2	0	River or tributary code
RM	N	5	2	River mile (to 1/20 rm)
SIDE	C	1	0	Side of river looking downstream
TBM	C	8	0	Temporary benchmark location code
GAGE_BEG	N	4	0	River stage at beginning of sample
GAGE_END	N	4	0	River stage at end of sample
TIME_BEG	N	4	0	Time at start of sample
TIME_END	N	4	0	Time at end of sample
LC_MC_FLOW	N	5	0	Approximate discharge in cfs
SHORETYPE	C	15	0	Shoreline type
CREW	C	8	0	Initials of crew members
FISHPRESNT	C	1	0	Fish present
COMMENTS	C	20	0	Comments
TRAN_NUM	N	2	0	Transect number
DIST_05_DP	N	5	2	Depth 0.5 meters from shore (ft)
DIST_05_VL	N	5	2	Velocity at 0.6 depth, 0.5 meters from shore (ft/s)
DIST_05_S1	C	2	0	Dominant substrate 0.5 meters from shore
DIST_05_S2	C	2	0	Secondary substrate 0.5 meters from shore
DIST_10_DP	N	5	2	Depth 1.0 meter from shore (ft)
DIST_10_VL	N	5	2	Velocity at 0.6 depth, 1.0 meter from shore (ft/s)
DIST_10_S1	C	2	0	Dominant substrate 1.0 meter from shore
DIST_10_S2	C	2	0	Secondary substrate 1.0 meter from shore
DIST_15_DP	N	5	2	Depth 1.5 meters from shore (ft)
DIST_15_VL	N	5	2	Velocity at 0.6 depth, 1.5 meters from shore (ft/s)
DIST_15_S1	C	2	0	Dominant substrate 1.5 meters from shore
DIST_15_S2	C	2	0	Secondary substrate 1.5 meters from shore
DIST_25_DP	N	5	2	Depth 2.5 meters from shore (ft)
DIST_25_VL	N	5	2	Velocity at 0.6 depth, 2.5 meters from shore (ft/s)
DIST_25_S1	C	2	0	Dominant substrate 2.5 meters from shore
DIST_25_S2	C	2	0	Secondary substrate 2.5 meters from shore

File: **SCALES.DBF**
Contents: **Humpback chub scale analysis, Oct 1990-Nov 1993**

Field	Type	Size	Dec	Description
BOX	C	2	0	Box number of slide location
FISH_NO	C	2	0	Sequential fish number
SINGLE	C	1	0	Marks one of multiple scales per fish
SAMPLE_NO	C	8	0	Unique sample identifier
DATE	N	6	0	Date (year,month,day)
SPECIES	C	2	0	Fish species code
RIVER_MILE	N	6	2	Mainstem river mile (to 1/20 rm)
METERS	N	5	0	Meters from tributary mouth (for AGF scales)
TL	N	3	0	Total length (mm)
SL	N	3	0	Standard length (mm)
SCALE_RAD	N	4	1	Length from nucleus to scale margin (μm)
NO_CIRC	N	2	0	Total number of circuli
A1	N	4	1	First annulus from nucleus (μm)
NO_CIRC_A1	N	2	0	Number of circuli to first annulus
A2	N	4	1	Second annulus from nucleus (μm)
NO_CIRC_A2	N	2	0	Number of circuli to second annulus
A3	N	4	1	Third annulus from nucleus (μm)
NO_CIRC_A3	N	2	0	Number of circuli to third annulus
A4	N	4	1	Fourth annulus from nucleus (μm)
NO_CIRC_A4	N	2	0	Number of circuli to fourth annulus
A5	N	4	1	Fifth annulus from nucleus (μm)
NO_CIRC_A5	N	2	0	Number of circuli to fifth annulus
A6	N	4	1	Sixth annulus from nucleus (μm)
NO_CIRC_A6	N	2	0	Number of circuli to sixth annulus
X	N	4	1	Length from nucleus to transitional check (μm)
NO_CIRC_X	N	2	0	Number of circuli to transitional check
AGE	N	1	0	Age of fish when scale collected
YEAR_CLASS	N	4	0	Year fish was hatched
RELIABLE	C	1	0	Reliability of scale information
PCX	N	5	2	Proportional total length at trans. check
BCX	N	5	2	Back-calculated total length at trans. check (mm)
BC1	N	5	2	Back-calculated total length at first annulus (mm)
PC1	N	5	2	Proportional total length at first annulus
BC2	N	5	2	Back-calculated total length at second annulus (mm)
BC3	N	5	2	Back-calculated total length at third annulus (mm)
BC4	N	5	2	Back-calculated total length at fourth annulus (mm)
BC5	N	5	2	Back-calculated total length at fifth annulus (mm)
BC6	N	5	2	Back-calculated total length at sixth annulus (mm)

A-6. PAST COLLECTIONS FILE STRUCTURES

The following structures were described by Kubly (1990). Data field descriptions are not available at this time.

File: **MNACATCH.DBF**
Contents: **Carothers et al. catch file**

Field	Type	Size	Dec	Description
WACODE	N	4	0	
WATER	C	5	0	
GEAR	N	1	0	
DATE	N	6	0	
EFFORT	N	5	0	
STATION	C	5	0	
TIME	N	4	0	
SPECIES	C	3	0	
LENGTH	N	5	0	
WEIGHT	N	5	0	
SEX	C	1	0	
MAT	N	1	0	
TAGNO	N	10	0	
RECAPNO	N	10	0	

File: **LKRARE.DBF**
Contents: **Kaeding and Zimmerman rare file**

Field	Type	Size	Dec	Description
RIVER	C	2	0	
STRATUM	C	1	0	
RIVERMILE	N	4	1	
TYPE	C	1	0	
DATE	C	6	0	
START	N	4	0	
STOP	N	4	0	
GEAR	C	2	0	
HAB_1	C	2	0	
HAB_2	C	2	0	
DEPTH	N	4	1	
VELOCITY	N	3	1	
SUBSTR_1	C	2	0	
SUBSTR_2	C	2	0	
SPECIES	C	2	0	
SEX	C	1	0	
TL_MM	N	5	0	
WT_G	N	5	1	
DORSFIN	N	2	0	
ANALFIN	N	2	0	
P1_P2	N	3	1	
D	N	3	1	
TAGNO	C	5	0	
COLOR	C	1	0	
RECAP	C	1	0	
LERNAEA	N	8	0	
DEPOSITION	C	2	0	
AGECLASS	C	2	0	

File: **LKPHYS.DBF**
Contents: **Kaeding and Zimmerman physical file**

Field	Type	Size	Dec	Description
RIVER	C	2	0	
STRATUM	C	1	0	
RIVERMILE	N	3	1	
DATE	N	6	0	
TIME	N	4	0	
H2OTEMP_C	N	3	1	
AIRTEMP_C	N	2	0	
DO_PPM	N	2	0	
CONDUCT	N	4	0	
SALIN	N	2	1	
TURB	N	2	0	
PH	N	2	1	
WIDTH_1	N	3	0	
MAXD_1	N	3	1	
MEAND_1	N	3	1	
S2D_1	N	4	1	
WIDTH_2	N	3	0	
MAXD_2	N	3	1	
MEAND_2	N	3	1	
S2D_2	N	4	1	
WIDTH_3	N	3	0	
MAXD_3	N	3	1	
MEAND_3	N	3	1	
S2D_3	N	4	1	

File: **LKCATCH.DBF**
Contents: **Kaeding and Zimmerman catch file**

Field	Type	Size	Dec	Description
STRATUM	N	1	0	
RIVERMILE	N	4	1	
TYPE	C	1	0	
DATE	N	6	0	
START	N	4	0	
STOP	N	4	0	
GEAR	C	2	0	
HAB_1	C	2	0	
HAB_2	C	2	0	
AREA	N	4	0	
DEPTH	N	4	1	
VELOCITY	N	3	1	
SUBSTR_1	C	2	0	
SUBSTR_2	C	2	0	
SPECIES	C	2	0	
YOY	N	4	0	
JUV	N	3	0	
ADU	N	3	0	

File: **AGFDLARV.DBF**
Contents: **AGFD larval fish file**

Field	Type	Size	Dec	Description
WACODE	N	4	0	
HAB	C	1	0	
SUB	C	1	0	
COVER	C	1	0	
TEMP	N	4	0	
GEAR	N	1	0	
MONTH	N	2	0	
DAY	N	2	0	
YEAR	N	2	0	
EFFORT	N	5	0	
STATION	C	5	0	
TIME	N	4	0	
SPECIES	C	3	0	
LENGTH	N	5	0	
WEIGHT	N	5	0	
COLNO	N	3	0	
DEPTH	N	4	0	
VELOCITY	N	4	0	
NAME	C	4	0	

File: **AGFDHAB.DBF**
Contents: **AGFD habitat file**

Field	Type	Size	Dec	Description
MONTH	N	2	0	
DAY	N	2	0	
YEAR	N	2	0	
NAME	C	20	0	
RIVERMILE	N	5	0	
POWER	C	1	0	
TIME	N	4	0	
SHORE	C	1	0	
HAB	C	1	0	
SUB	C	1	0	
VEG	C	1	0	
SPECIES	C	3	0	
AGE	C	1	0	

A-6. Historical Collections File Structures - cont.

File: **AGFCATCH.DBF**
Contents: **AGFD catch file**

Field	Type	Size	Dec	Description
WACODE	N	4	0	
WATER	C	5	0	
GEAR	N	1	0	
DATE	N	6	0	
EFFORT	N	5	0	
STATION	C	5	0	
TIME	N	4	0	
SPECIES	C	3	0	
LENGTH	N	5	0	
WEIGHT	N	5	0	
SEX	C	1	0	
MAT	N	1	0	
TAGNO	N	10	0	
RECAPNO	N	10	0	

APPENDIX B

DATABASE CODE DEFINITIONS

B-1. ARIZONA STATE UNIVERSITY DATABASE CODE DEFINITIONS

CAMP

C	Confluence
P	Powell
S	Salt

TRIP

Numbered sequentially from 1-12+ for a given year

YEAR CODE

A	1991
B	1992
C	1993
etc	

WACODE

22	Little Colorado River

LOCATION

USFWS transect code and/or generic site name

GEAR

2	Trammel
3	Seine
5	Hoop
6	Angling

SPECIES

RBT	Rainbow trout
BRT	Brown trout
HBC	Humpback chub
STB	Striped bass
FHM	Fathead minnow
RGK	RioGrand killifish
CRP	Common carp
SD	Speckled dace
FMS	Flannelmouth sucker
CCF	Channel catfish
BHS	Bluehead sucker
BBH	Black bullhead
YBH	Yellow bullhead
RBS	Razorback sucker
BG	Bluegill

SEX

0	Unknown
1	Male
2	Female

MATURITY

0	Immature
2	Mature
3	Ripe
4	Spent
6	Mortality

B-2. U.S. FISH AND WILDLIFE SERVICE DATABASE CODE DEFINITIONS

GEAR	
AHP	ASU hoopnet
MNP	FWS mini-hoopnet
MTP	FWS minnow trap
SEN	FWS seine
TRN	FWS transect
ICM	ICM meter
HDL	Hydrolab
HDLL	Hydrolab with logger

GEARD (mesh, # hoops, hoop diameter)		
mesh	25	1/4"
	50	1/2"
# hoops	4	
	5	
	6	
	etc.	
diameter	50	
	60	
	70	
	80	
	90	

CUR	
0	none (0-.02 m/s)
1	very slow (.02-.10 m/s)
2	slow (.10-.30 m/s)
3	moderate (.30-.70 m/s)
4	fast (.70-1.20 m/s)
5	very fast (>1.20 m/s)

CC (current comments)	
E	backcurrent or eddy
T	turbulent flow
P	plunge pool or waterfall
+	slightly faster current
-	slightly slower current

SUB	
M	marl
0	silt or marl (<.06 mm)
1	silt-sand (.07-.10 mm)
2	sand (.11-2.0 mm)
3	gravel (2.1-15 mm)
4	pebble (16-31 mm)
5	rock (32-100 mm)
6	cobble (101-255 mm)
7	small boulder (256-1000 mm)
8	boulder (1-3 m)
9	large boulder (>3 m)
10 or T	travertine
11	bedrock

SBC (substrate descriptor)	
M	marl
T	travertine
H	rough or horny travertine
Q	travertine dam or terrace
B	smooth or bottom/basement travertine
V	vegetation
A	algae
P	pondweed
R	roots
F	phragmites stems
C	cattail stems
S	shrubs or small tree
D	detritus
W	wood
L	leaves
G	dry ground or land
Z	particle is composed of solid travertine

M	
0	20m transect
1	100m transect

CVR	
0	none
1	slight
2	little
3	moderate
4	extensive
5-8	deep water cover negative values unsuitable habitat

VER	
0	no vertical structure
1	V in OVH and depth 10-25 cm
2	V in OVH and depth 25-50 cm
3	V in OVH and depth 50-100 cm
4	V in OVH and depth >100 cm
+1	E and O,L,U, or W in OVH and depth >25 cm

VEG	
0	no vegetation
1	small macrophytes or filamentous algae
2	roots and small emergent vegetation, rushes
3	large emergent vegetation

MAR	
0	no marl
1	mixture of marl and silt or sand
2	marl coating on larger substrates
3	thick marl deposit as primary substrate

TRA	
0	no travertine
1	travertine coated substrates
2	smooth or rough travertine as primary substrate

B-2. U.S. Fish and Wildlife Service Database Code Definitions - cont.

3	rough travertine and solid travertine masses associated with travertine dams and reefs

SHA

0	<10% or no shade
1	10-50% shade
2	50-75% shade
3	>75% shade

DEB

0	no debris
1	detritus and leaves
2	sticks and small logs
3	large submerged logs

PER

M	midnight sample (22:00-02:00)
A	night time sample (02:00-10:00)
P	daytime sample (10:00-22:00)

SPP

HBC	humpback chub
BHS	bluehead sucker
FMS	flannelmouth sucker
SPD	speckled dace
CCF	channel catfish
FHM	fathead minnow
CCP	common carp
KLF	plains killifish
RBT	rainbow trout
BNT	brown trout
CUT	cutthroat trout
GSF	green sunfish
LMB	largemouth bass
RBS	razorback sucker
RSH	red shiner

FIN

UCRP	upper caudal, right pectoral
UCLP	upper caudal, left pectoral
LCRP	lower caudal, right pectoral
LCLP	lower caudal, left pectoral

CAMP

S	Salt camp
P	Powell camp
A	Atomizer
B	Blue Springs
C	confluence

SECCHI

0	<0.5
1	0.5-1.0

B-3. ARIZONA GAME AND FISH DATABASE CODE DEFINITIONS
Little Colorado River

REACH

022	Little Colorado River
020	Colorado above LCR
030	Colorado below LCR

MILE

Confluence at 61.5
Use meters above mouth for LCR

SIDE

L	Left (looking downstream)
R	Right (looking downstream)
C	Center

GEAR-TYPE

BS	Bag Seine
SS	Straight Seine
MT	Minnow Trap
HN	Hoop Net (round, no leads)
AN	Angling
DP	Dip Net

GEAR-H (height)

Record to the nearest ft.

GEAR-L (length)

Record to the nearest ft.

GEAR-M (mesh)

0.03	1/32 in.
0.06	1/16 in.
0.12	1/8 in.
0.25	1/4 in.
0.50	1/2 in.
0.75	3/4 in.
1.00	1 in.
1.50	1-1/2 in.
2.00	2 in.
E	Experimental

AREAL EFFORT-LEN

Length of seine haul to nearest meter
Length of dip net sweep to nearest cm

AREAL EFFORT-WID

Width of seine haul to nearest meter
Width of dip net to nearest cm

CHANNEL TYPE

MC	Main Channel
SC	Side Channel
TS	Tributary Stream
TM	Tributary Mouth

1° HABITAT

CB	Connected backwater
IB	Isolated backwater
ED	Eddy
RI	Riffle
RU	Run
EW	Edgewater
CO	Cove
SC	Springflow Channel (arising from sidechannel)
PO	Pool

2° HABITAT

PL	Plunge Pool
DP	Dammed Pool
PW	Pocket Water (pool)
TP	Travertine Pool
LP	Lateral Scour Pool
PP	Peripheral Pool
CA	Cascade (riffle)

SUBSTRATE

BD	Bedrock (>4.096 m)
BO	Boulder (0.256-4.096 m)
CO	Cobble (64-256 mm)
PB	Pebble (32-64 mm)
GR	Gravel (2-32 mm)
SA	Sand (0.062-2 mm)
SI	Silt (4-62 µm)
CL	Clay (0.24-4 µm)
DE	Detritus
CC	Calcium carbonate floc
TR	Travertine (tufa)

FEATURES

DE	Depth >0.5 m
TU	Turbulence
LE	Ledge
BO	Boulder
UB	Undercut Bank
TD	Turbidity
OV	Overhanging Vegetation
IV	Instream Vegetation
WD	Woody Debris
DA	Dam (upstream)

SPECIES

BHS	Bluehead mountain sucker
FMS	Flannelmouth sucker
RBS	Razorback sucker
SUC	Unidentified sucker
HBC	Humpback chub
SPD	Speckled dace
FHM	Fathead minnow
RSH	Red shiner
CRP	Carp
PKF	Plains killifish
CCF	Channel catfish

B-3. Arizona Game and Fish Database Code Definitions - cont.
Little Colorado River

RBT	Rainbow trout
UID	Unidentified species
SHY	Sucker hybrid

SEX

M	Male
F	Female
U	Undetermined
N	Determination not attempted

MAT (maturity)

3	Ripe-gametes extrudable
4	Spent female-fish has expelled gametes
5	Tuberculate (not ripe)
6	Undeterminable
7	Not attempted

PAR #

Number of external parasites (Lernea) visible
Record location codes in comments!

EXT-Y/N (external tag) - Record type code, color code, and number in Comments

F	Floy tag (type)
C	Carlin tag (type)
Y	Yellow
G	Green
B	Blue
O	Orange
R	Red

HEAD-STOM - Record 2-letter code followed by 2-digit number

HE	Head, ethanol
SF	Stomach, formalin
BE	Body (entire fish), ethanol
BF	Body (entire fish), formalin
HS	Head and stomach preserved in ethanol and formalin, respectively

DIS (disposition)

RA	Released alive
DN	Dead, not taken
DP	Dead, preserved
DS	Dead, skeletonized
SP	Sacrificed, preserved
SS	Sacrificed, skeletonized
MN	Mortality, not taken
MP	Mortality, preserved
MS	Mortality, skeletonized

COMMENT CODES

00	Fishless
01	Coloration
02	Fishless w/ qualification
03	Equipment failure
04	External tag
05	Body scars/bruising
06	Predator bite scars
07	Fin condition
08	Pulled net
09	Pit tag/external tag scar
10	Upper caudal + RP2 fin clips
11	Upper caudal + LP2 fin clips
12	Lower caudal + RP2 fin clips
13	Lower caudal + LP2 fin clips
14	Dorsal fin punch
15	Caudal fin punch
16	Radio tagged
20	Escaped
21	PIT tagged but number not recorded
22	More than one tag injected
23	Collected from longitudinal survey
24	Proto larva
25	Meso larva
26	Meta larva

LENGTH

01	<6 mm
02	6-10 mm
03	11-20 mm
04	21-30 mm
05	31-40 mm
06	41-50 mm
07	51-60 mm
08	61-70 mm
09	71-80 mm
10	81-90 mm
11	91-100 mm
etc	

HABTYPE

PP	Periferal pool
VS	Vegetated shoreline
OS	Non-vegetated shoreline
SC	Spring-flow channel

B-3. Arizona Game and Fish Database Code Definitions - cont.
Little Colorado River

DRIFT AND VISCERA INVERTEBRATE CODE SHEET

INSECTS	
Diptera	DPA
Simulidae	SIM
Chironomidae	CHI
Empididae	EMP
Ceratopogonida	CPG
Dixidae	DIX
Dolichopodidae	DOL
Sciaridae	SCI
Ephydridae	EPY
Schizophora-DIV	SCZ
Trixoscelidae	TRX
Hemiptera	HMA
Gerridae	GER
Veliidae	VEL
Miridae	MIR
Tingidae	TNG
Berytidae	BEY
Saldidae	SAL
Hebridae	HEB
Mesoveliidae	MES
Macroveliidae	MAC
Homoptera	HOM
Cicadellidae	CDL
Aphididae	APH
Psyllidae	PSY
Trichoptera	TRI
Hydropsychidae	HPS
Hydroptilidae	HPT
Hymenoptera	HYM
Encyrtidae	ENC
Pteromalidae	PTE
Formicidae	FOR
Braconidae	BRA
Eulophidae	EUL
Apoidea	APO
Eurytomidae	EUR
Coleoptera	CLA
Elmidae	ELM
Dryopidae	DRY
Chrysomelidae	CHR
Curculionoidae	CUR
Hydrophilidae	HYP
Ephemeroptera	EPH
Baetidae	BAT
Siphlonuridae	SIP
Megaloptera	MEG
Corydalidae	CYD
Embioptera	EMB
Odonata	ODO
Gomphidae	GPH
Thysanoptera	THY
Thripidae	THR
Phloeothripidae	PHL
Collembola	COL
Psocoptera	PSO
Plecoptera	PLE
Neuroptera	NEU
Thysanura	THU
Orthoptera	ORT
Lepidoptera	LEP
Stretsiptera	STR
Isoptera	ISO
Mallophaga	MLO
OTHERS	
Araneida	ARA
Acarina	ACA
Hydracarina	HYD
Ostrocoda	OST
Amphibia	AMP
Bufo	BFO
Mollusca	MOL
Bivalvia	BIV
Gastropoda	GAS
Tapeworm(s)	TPW
Nematoda	NEM
Annelids	ANN
Hirundea	HIR
Oligochaeta	OLI
Rotifera	ROT
Cladocera	CLC
Copepoda	COP
Taxa	TAX
Chlorohydra	HYA
WHOLE SAMPLE	
Fish(UKN)	FFF
Sucker	SUW
Flannel Mth	FMW
Bluehead	BHW
Speck. Dace	SPW
Humpback Chub	HBW
Fathead Minn.	FHW
Killifish	PKW
Catfish	CCW
Carp	CRW
QUARTER SAMPLE	
FISH (UKN)	FHS
Sucker	SUC
Flannel Mth	FMS
Bluehead	BHS
Speck Dace	SPD
Humpback Chub	HBC
Fathead Minn.	FHM
Killifish	PKF
Catfish	CCF
Carp	CRP
Eggs(UKN)	EGG
Fish eggs-100%	EEE
Fish eggs-25%	EGF
Insect eggs	EGI
Amph. eggs	EGA
MISCS.	
Body parts	BPS
Pollen	POL
Seeds	SEE
Crustacea	CRU
Algae	ALG
Other Misc. Org.	OMO
Detritus	DET
Sand, Gravel	ROC
Empty	EPT
LIFE STAGE	
Adult	A
Pupae	P
Larva	L
Nymph	N
Prolarva	R
Mesolarva	M
Metalarva	T
Juvenile	J
MATURITY	
No Maturity	0
Many Sm eggs	1
Mature	2
Ripe	3
Spent	4
Unknown Mat.	6
PARASITE CODES	
None	0
1-10	1
11-100+	2

B-3. ARIZONA GAME AND FISH DATABASE CODE DEFINITIONS
Mainstem Colorado River

AMB_LITE: Ambient Light Codes

SU	Sunny
PC	PTly Cloudy (<50% cloud cover)
CL	Cloudy (>50% cloud cover)
SH	Shade
NI	Night
ML	Moonlight
DN	Dawn
DK	Dusk

DISP: Disposition codes

RA	Released Alive
MN	Mortality
MP	Mortality, Preserved
SP	Sacrificed, Preserved
OB	Observed

FLOW_CD: Flow Codes

AC	Ascending
DC	Descending
SH	Stable High
SL	Stable Low

GEAR_CD: Gear codes

BS	Small Bag Seine 15' x 6' x 1/8" (1/32" bag mesh)
BL	Large Bag Seine 30' x 6' x 1/4" (1/8" bag mesh)
SS	Small Straight Seine 15' x 4' x 1/8"
SL	Large Straight Seine 30' x 6' x 1/16"
KS	Kick Seine 3' x 3' x 1/32"
DS	Small Mesh Dip Net 1/16"
DL	Large Mesh Dip Net 3/16"
MH	Mini-Hoop Net 1.5' x 4' x 3/8"
HN	Hoop Net 3' x 5' x 3/8" x 40' wings
TN	Trammel Net (Set)
TS	Trammel Net (Used As A Seine)
LD	Larval Drift
MT	Minnow Trap
AN	Angling

HAB_CD: Habitat Codes

Backwaters

BE	Backwater Eddy
BW	Backwater
BM	Backwater Mouth - Connected Mouth
BC	Backwater Center - Connected Center
CB	Connected Backwater
CC	Connected Center
CE	Connected Eddy
CF	Connected Foot
CM	Connected Mouth
DW	Dewatered (used for trap sets)
IB	Isolated Backwater
IP	Isolated Pool
SC	Side Channel

Mainchannel

BF	Beach Face
BO	Boulder Shoreline
CO	Cove
DM	Dewatered (used for trap sets)
ED	Eddy
MC	Mainchannel
ME	Mainchannel Eddy
MR	Main River
MS	Mainstream
SC	Side Channel

Tributaries

DT	Dewatered (used for trap sets)
ED	Eddy
PO	Pool
RA	Rapid
RI	Riffle
RU	Run
TM	Tributary Mouth
TS	Tributary Side Channel
PL	Pool
TS	Tributary Side Channel
TB	Tributary

LIFE_STAGE: Life stage codes for diet analysis

A	Adult
P	Pupae
L	Larva
N	Nymph
R	Prolarva
M	Mesolarva
T	Metalarva
J	Juvenile
U	Unknown

MATURITY

0	Larval, Juvenile
1	Adult, Non-breeding
2	Gravid
3	Ripe
4	Spent
5	Tuberculate
6	Undetermined
7	Not Attempted
8	High Color

PARASITE

0	None
1	1-10
2	11-100+

REACH

010	Mainstem: Glen Canyon Dam to Lees Ferry (RM 0)
011	Paria River (RM 0.9)
020	Mainstem: Lees Ferry to Little Colorado River (RM 61.5)
021	Nankoweap Creek (RM 52.2R)

B-3. Arizona Game and Fish Database Code Definitions - cont.
Mainstem Colorado River

022	Little Colorado R. (RM61.5L)
030	Mainstem: LCR to Bright Angel Creek (RM 87.62)
031	Clear Creek (RM 84.03R)
032	Bright Angel Creek (RM 87.62R)
040	Mainstem: Bright Angel to National Canyon (RM 166.4)
401	Pipe Creek (RM 88.95L)
041	Crystal Creek (RM 98.04R)
042	Shinumo Creek (RM 108.6R)
402	Elves Chasm (RM 116.5L)
403	Stone Creek (RM 131.8R)
043	Tapeats Creek (RM 133.83R)
044	Deer Creek (RM 136.25R)
045	Kanab Creek (RM 143.5R)
404	Olo Canyon (RM 145.5L)
046	Havasu Creek (RM 156.93L)
047	Diamond Creek (RM 225.6L)
050	Mainstem: National Canyon to Diamond Creek (RM 225.6)
060	Mainstem: Diamond Creek to Lake Mead (RM 270?)
061	Travertine Creek (RM 229.0L)
062	Spencer Creek (RM 246.0)

Sex Codes

F	Female
M	Male

SPECIES

Common Species

BBH	Black Bullhead
BGS	Bluegill
BHS	Bluehead Sucker
BKT	Brook Trout
BNT	Brown Trout
CCF	Channel Catfish
CRP	Common Carp
CUT	Cutthroat Trout
FMS	Flannelmouth Sucker
GSH	Golden Shiner
HBC	Humpback Chub
LMB	Largemouth Bass
PKF	Plains Killifish
RBS	Razorback Sucker
RBT	Rainbow Trout
RSH	Red Shiner
SMB	Smallmouth Bass
SPD	Speckled Dace
STB	Striped Bass
TFS	Threadfin Shad
UTC	Utah Chub
YBH	Yellow Bullhead
SUC	Sucker (unidentified)
UID	Unidentified

SUBST_CD: Substrate Codes

SI	Silt
SA	Sand
GR	Gravel
PE	Pebble
CO	Cobble
BO	Boulder
BD	Bedrock

TAG: Tag Codes and Fin Clips/Punches

Tag Types

C	Carlin
F	Floy
P	PIT

Fin Clips/Punches

D	Dorsal
UC	Upper Caudal
LC	Lower Caudal
CD	Caudal
RP2	Right Pelvic
LP2	Left Pelvic

TAXA

ALG	Algae
ACA	Acarina
AMP	Amphibia
ANN	Annelids
APD	Amphipod
APH	Aphididae
APO	Apoidea
ARA	Araneida
BAT	Baetidae
BEY	Berytidae
BFO	Bufo
BIV	Bivalvia
BPS	Body parts
BRA	Braconidae
CDL	Cicadellidae
CHI	Chironomidae
CHR	Chrysomelidae
CIL	Ciliate
CLA	Coleoptera
CLC	Cladocera
COL	Collembola
COP	Copepoda
CPG	Ceratopogonidae
CRU	Crustacean
CST	Cestoda
CUR	Curculionoidae
CYD	Corydalidae
DET	Detritus
DIA	Diatom
DIX	Dixidae
DOL	Dolichopodidae
DPA	Diptera
DRY	Dryopidae
ECT	Ectoproct
ELM	Elmidae
EMB	Embioptera
EMP	Empididae
ENC	Encyrtidae
EPH	Ephemeroptera

B-3. Arizona Game and Fish Database Code Definitions - cont.
Mainstem Colorado River

EPT	Empty	VOL	Volvox
EPY	Ephydridae		
EUL	Eulophidae		
EUR	Eurytomidae		
FOR	Formicidae		
GAS	Gastropoda		
GER	Gerridae		
GPH	Gomphidae		
HEB	Hebridae		
HIR	Hirundea		
HMA	Hemiptera		
HOM	Homoptera		
HPS	Hydropsychidae		
HPT	Hydroptilidae		
HYA	Chlorohydra		
HYD	Hydracarina		
HYM	Hymenoptera		
HYP	Hydrophilidae		
ISO	Isoptera		
LEP	Lepidoptera		
MAC	Macroveliidae		
MEG	Megaloptera		
MES	Mesoveliidae		
MIR	Miridae		
MLO	Mallophaga		
MOL	Mollusca		
NAP	Copepod nauplius		
NEM	Nematoda		
NEU	Neuroptera		
ODO	Odonata		
OLI	Oligochaeta		
OMO	Other Misc. Org.		
ONP	Ostracod nauplius		
ORT	Orthoptera		
OST	Ostrocoda		
PHL	Phloeothripidae		
PLE	Plecoptera		
POL	Pollen		
PRO	Protozoan		
PSO	Psocoptera		
PSY	Psyllidae		
PTE	Pteromalidae		
ROC	Sand, Gravel		
ROT	Rotifera		
SAL	Saldidae		
SCI	Sciaridae		
SCZ	Schizophora		
SEE	Seeds		
SIM	Simulidae		
SIP	Siphlonuridae		
STR	Stretsiptera		
THR	Thripidae		
THU	Thysanura		
THY	Thysanoptera		
TIP	Tipulidae		
TNG	Tingidae		
TRI	Trichoptera		
TRX	Trixoscelidae		
VEL	Veliidae		

B-4. BIO/WEST Inc., DATABASE CODE DEFINITIONS

AMBIENT LIGHT

SU	Sunny
CL	Cloudy (> 50% cloud cover)
PC	Partly cloudy (< or 50% cloud cover)
SH	Shadow
NI	Night
ML	Moonlight
DD	Dawn/dusk

DISPOSITION

RA	Returned alive (no radio implant)
RI	Returned with newly implanted radio
RR	Returned with active radio transmitter
RN	Returned with non-active radio transmitter (removed external antennae but did not re-implant)
RS	Returned alive with stomach contents removed
DR	Dead, released (non-native fish)
DP	Dead, preserved
DS	Dead, stomach contents preserved

FLUCTUATIONS OR FLUCT

RI	Rising
FA	Falling
SL	Steady at a low stage
SH	Steady at a high stage

GEAR

EL	Electrofishing
BP	Backpack electrofishing
FR	Frame net
SA	10'x3'x1/8" seine
SB	30'x4'x1/4" seine
SC	15'x4'x1/8" seine
SG	30'x5'x1/4" seine
DL	Larval fish drift net
DR	Invert drift net
SU	Surber
AQ	Aquarium net
KS	Kick screen
TK	75'x6'x1"x12" Trammel net
TL	75'x6'x1 1/2"x12" Trammel net
TF	Floated Trammel net RECORD AREA SAMPLED
TM	50'x6'x1"x12" Trammel net
TN	50'x6'x1.5"x12"
GM	100'x6'x2" gill net
GP	100'x6'x1 1/2" gill net
GX	100' experimental gill net
GZ	60' experimental gill net
GY	50'x6'x1.5" gill net
GF	Floated gill net RECORD AREA SAMPLED
MT	Minnow trap
HL	Large hoop net (4' diam.)
HM	Medium hoop net (3' diam.)
HS	Small hoop net (2' diam.)
AN	Angling
TW	75'x6'x1/2"x10
TZ	TL with attached floats
TY	TK with attached floats

HAB1: General habitat

MC	Main channel
TS	Tributary stream
SC	Side channel
LK	Lake

HAB2: Specific habitat

BA	Backwater
ED	Eddy
EM	Embayment
RI	Riffle
RU	Run
SH	Shoreline
PO	Pool
RC	Return channel

HAB3: Shoreline habitat

TS	Talus scree
SW	Shear wall
LE	Ledge
BE	Bedrock
SI	Silt
SA	Sand
CO	Cobble
BO	Boulder field
CB	Cut bank
VG	Vegetation
DF	Debris flow
TV	Travertine

RIPE: State of gonadal maturity of fish

TU	Tubercled only
TC	Tubercled and colored
MI	Running milt
EG	Expressible eggs
SP	Spent
CO	Colored only

SUB1: Dominant substrate

SI	Silt
SA	Sand
GR	Gravel
CO	Cobble
BO	Boulder
BE	Bedrock
OR	Organic matter

SUB2: Secondary substrate

SI	Silt
SA	Sand
GR	Gravel
CO	Cobble
BO	Boulder

B-4. BIO/WEST, Inc. Database Code Definitions - cont.

BE	Bedrock
OR	Organic matter

TURBIDITY OR TURB

H	High secchi = < 0.5m
L	Low secchi = > 0.5m

WEATHER

SU	Sunny
CS	(SU) clear skies
CL	Cloudy (> 50% cloud cover)
PC	Partly cloudy (< or 50% cloud cover)
OV	Overcast or foggy
RA	Raining
SN	Snowing

SPECIES CODE OR SPECIES: Code for fish species

HB	Humpback chub
FM	Flannelmouth sucker
BH	Bluehead sucker
SD	Speckled dace
RZ	Razorback sucker
FH	Fathead minnow
CC	Channel catfish
BB	Black bullhead
CP	Carp
RB	Rainbow trout
BR	Brown trout
BK	Brook trout
PK	Plains killifish (Fundulus zebrinus)
SB	Striped bass
WE	Walleye
FR	Flannelmouth X razorback hybrid
SU	Unidentified sucker
YB	Yellow bullhead
BG	Bluegill
GA	Gambusia
GS	Green sunfish
LG	Largemouth bass
RS	Red shiner
TS	Threadfin shad
BC	Black crappie
NP	Northern pike
RT	Roundtail chub
SH	Shiner (red or sand)
SM	Smallmouth bass
SS	Sandshiner

OLD TAG

UCRP2	Upper caudal plus RP2
UCLP2	Upper caudal plus LP2
LCRP2	Lower caudal plus RP2
LCLP2	Lower caudal plus LP2
DP	Dorsal punch
UCP	Upper caudal punch
LCP	Lower caudal punch
PIT	PIT tag number
Floy tag number	
Carlin tag number	

REACH

0	Lees Ferry to Kwagunt (RM 0-56.0)
1	Kwagunt to Hance (RM 56-76.6)
2	Hance to Havasu (RM 76.6-156.7)
3	Havasu to Diamond Creek (RM 156.7-226)
4	Diamond Creek to Pearce Ferry (RM 226-280)

RIVER

CO	Mainstem Colorado River
LC	Little Colorado River
BA	Bright Angel Creek
KN	Kanab Creek
HV	Havasu Creek
TP	Tapeats Creek
SH	Shinumo Creek
DC	Deer Creek
NK	Nankoweap
CL	Clear Creek
CR	Crystal Creek
ST	Stone Creek
CB	Carbon Creek
DI	Diamond Creek
SP	Spencer Creek
SU	Surprise Creek
LO	Lost Creek

SAMPLE TYPE

E	Electrofishing
N	Gill/Trammel nets
S	Seining
T	Traps,i.e. hoop nets, minnow traps

SEX

M	Male
F	Female
I	Immature
U	Undetermined

SIDE

R	River right (looking downstream)
L	River left (looking downstream)
C	Center (tributary hoop net sets)

CONFIDENCE

1	High, excellent reception
2	Low, poor reception
3	Only a few "hits", use for location only

COVER

OB	Overhanging bank
SV	Streamside vegetation
NC	No cover

MODE

IM	Implant

B-4. BIO/WEST, Inc. Database Code Definitions - cont.

LO	Locate
2H	2-hour
24	24-hour
TF	Test flow